Tissue-Tek® V.I.P.™

Ames
Division of Miles Laboratories, Inc.

MILES

SERVICE MANUAL

Vacuum Infiltration Processor (Bench and Floor Models)

	V.I.P. 1000
4617	100/115 Volt
4621	220/240 Volt
	V.I.P. 2000
4618	100/115 Volt
4622	220/240 Volt
	V.I.P. 3000
4619	110/115 Volt
4623	220/240 Volt

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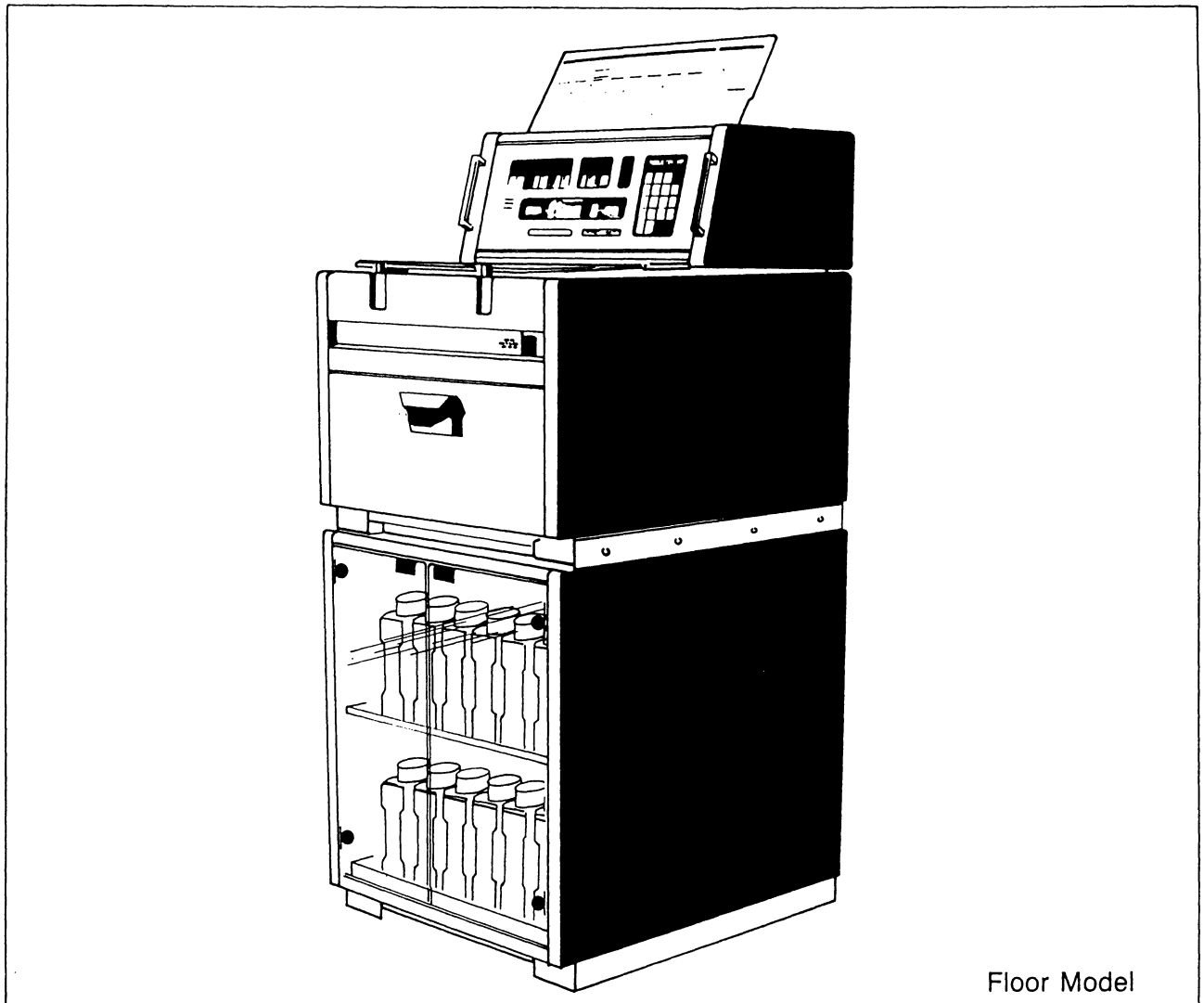
Information contained in this service manual is designed for troubleshooting and repair of the VIP by qualified and properly trained service personnel using proper tools and test equipment. IF YOU DO NOT POSSESS THE PROPER TOOLS AND EQUIPMENT AND THE PROPER TECHNICAL TRAINING, YOU SHOULD NOT ATTEMPT TO SERVICE THE INSTRUMENT.



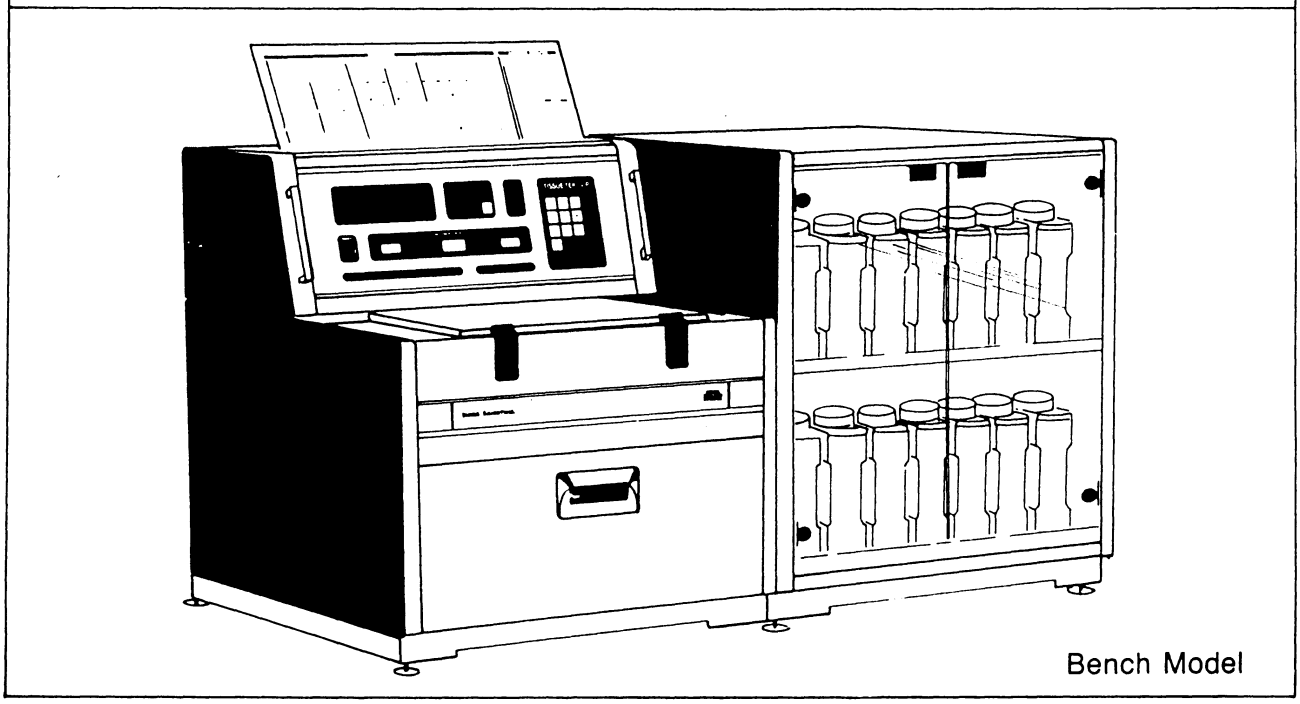


Figure 1-1. TISSUE-TEK V.I.P. 1000/2000/3000

Section 1 INTRODUCTION

1-1 USING THE MANUAL

1-1-1 This manual provides service information for the TISSUE-TEK V.I.P.™ 1000/2000/3000 Vacuum Infiltration Processor. (Figure 1-1)

General maintenance tasks are described in Section 2, which also contains instructions for making mechanical and electrical adjustments.

Methods of identifying and eliminating malfunctions are described in Section 3.

Repair is generally accomplished by replacing faulty modules, except the rotary valve and the pump heads, which can be rebuilt. Repair instructions are contained in Section 4.

Service procedures should be performed by trained service personnel only.

A list of replacement parts is contained in Section 5. Schematic diagrams are located in Section 6.

1-1-2 Instrument operating procedures and instrument care instructions are contained in the V.I.P. Operator's Manual for the model(s) involved.

1-2 INSTRUMENT DESCRIPTION

1-2-1 The V.I.P. is a unitized, self-contained instrument, requiring only an electrical power connection. It prepares 100, 200 or 300 tissue specimens for embedding, sectioning, and staining. It is equipped with automatic controls, programmable by the operator (see Figure 1-2), and liquid reservoirs for processing reagents to fix, dehydrate, clear, and paraffin-impregnate the tissue specimens.

1-2-2 The Tissue-Tek V.I.P. is available in two configurations: counter-top and floor models. In the counter-top configuration the reservoir rack is at the right of the retort and oven.

The floor configuration is mounted on casters, with the reservoir rack below the retort and oven. In both configurations the pressure/vacuum pump and manifolds are behind the reservoir rack.

1-2-3 The processing chamber of the instrument, called the retort, is stainless steel. The retort is equipped with a gasketed latching cover to maintain pressure or vacuum. Tissue specimens in cassettes are placed into baskets, which fit into the retort. An air inlet provides for pressurization or vacuum. A fluid duct at the bottom allows solutions to be pumped into or out of the retort.

1-2-4 Below the retort is a paraffin oven which holds paraffin pots (four pots in V.I.P. 1000 or 2000, three in V.I.P. 3000). Each pot is connected by Teflon tubing to the rotary valve, allowing paraffin movement into the retort. Fluid flow diagrams of the air/vacuum system are shown in Figure 1-3 and Appendix A.

1-2-5 Both the retort and the oven contain heaters to maintain the specimens at controlled temperatures as programmed for processing, and to maintain the paraffin in a liquid state. Retort temperature is operator-selectable for processing steps 1 through 14 (1 through 13 in V.I.P 3000). The oven temperature is determined by the average of the retort temperatures programmed for stations 11 through 14 (11 through 13 in V.I.P. 3000) plus 3°C.

1-2-6 The pressure/vacuum pump, the solenoid-operated air valves and the air manifolds are located in a compartment behind the reservoir rack, and are accessible from the rear of the instrument. These components produce the air pressure or vacuum in the retort for movement of liquids and alternating pressure and vacuum during processing.

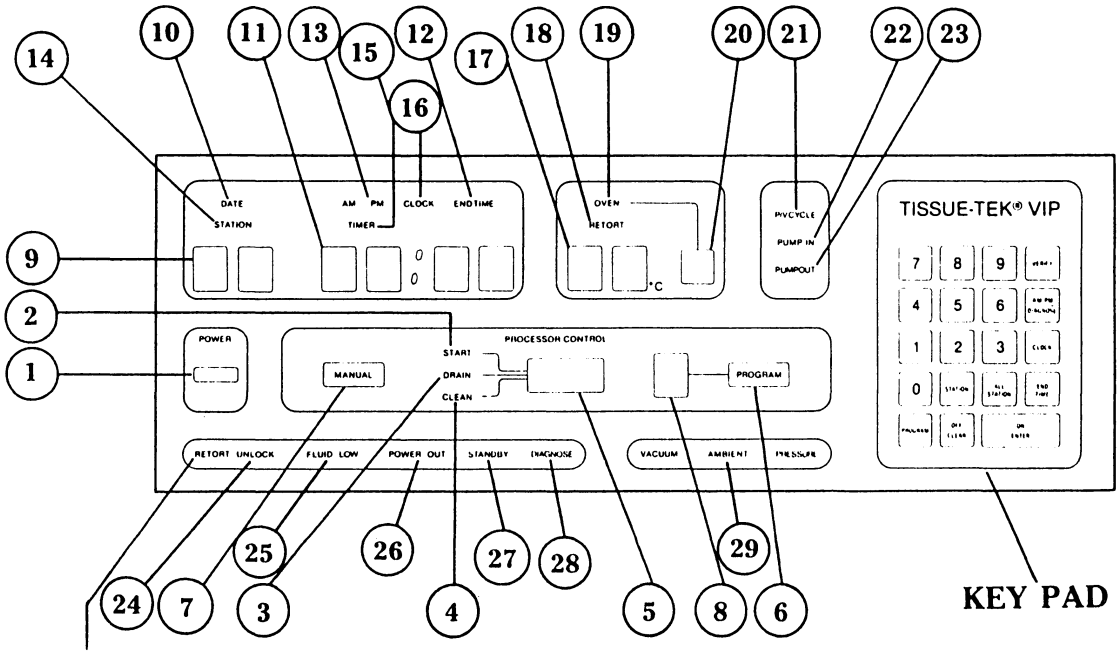
1-2-7 The electronics module, which includes the power supply, programming panel, displays, microprocessor-based control and battery circuit, is located above and to the rear of the retort. The 5.05 Vdc supply provides power for all microprocessor control and logic circuitry. The battery maintains the random access memory (RAM) in a powered condition in case of line power interruption. A fresh battery will hold the keypad-entered programs, interrupt vectors, and restart data for up to 30 days. Normal processing resumes automatically when line power is restored. Some delay will be experienced to allow temperatures to reach operating levels.

1-2-8 The reservoir rack is located in the right half of a counter-top model, or the lower half of a floor model. The total number of reservoirs is 14 of which ten (9 in V.I.P. 3000) are for specimen processing solutions, two are for cleaning solutions, and the last two are for exhaust gas treatment. Of these last two, one is for water and the last one contains activated carbon. The carbon container cannot be used for liquids since a portion of the bottom is perforated to allow filtered air or gas to escape. Selection of reagents for specimen processing is achieved by programming, and implemented by the rotary valve.

1-2-9 Below the reservoir rack is a covered spill tray. In the event of a liquid spill, reservoir or manifold leak, liquid will drain into the spill tray.

There is a spill tray under the paraffin oven, also. A retort overflow trap is located in the compartment behind the retort. Presence of liquid in the trap is detected by a capacitance type proximity switch; when an overflow is sensed, the pump will reverse and initiate a short "pump-out" cycle. The program will then be interrupted and an alarm will sound.

1-2-10 A self-diagnostic failure detection program is included in the control circuitry. If a failure is detected processing will be interrupted and the DIAGNOSE display will illuminate or flash. Pressing the AM-PM/



(1) Power Indicator
(2) Start Indicator
(3) Drain Indicator
(4) Clean Indicator
(5) Processor Control Button
(6) Program Switch
(7) Manual Switch
(8) Program Number Display
(9) Date and Station Display
(10) Date Indicator
(11) Timer, Clock, and End Time Display
(12) End Time Indicator
(13) Clock Indicator
(14) Station Indicator
(15) Timer Indicator
(16) Colon
(17) Temperature Display of Retort or Oven
(18) Retort Indicator
(19) Oven Indicator
(20) Temperature Display Select Button
(21) P/V Cycle Indicator
(22) Pump In Indicator
(23) Pump Out Indicator
(24) Retort Unlock Indicator
(25) Fluid Low Indicator
(26) Power Out Indicator
(27) Standby Indicator
(28) Diagnose Indicator
(29) Pressure, Ambient, and Vacuum Indicator (retort pressure status)

Figure 1-2. Controls of TISSUE-TEK V.I.P. 1000/2000/3000

DIAGNOSE key on the programming keyboard in response to the signal will then cause an error code (E—nn) to be displayed under TIMER. The error code enables the serviceman to identify the failure by reference to Table 3-1.

1-2-11 Diagnose and other types of system failures will trigger an alarm relay which can provide a remote alarm indication.

1-3 THEORY OF OPERATION

1-3-1 Instrument power is controlled by a circuit breaker on the rear of the instrument behind the control panel.

1-3-2 Tissue specimens, held in tissue cassettes, are placed in stainless steel baskets which are put into the instrument retort. The retort cover is then closed and latched. Automatic operation begins when the instrument PROCESSOR CONTROL button is pressed. A short tap will suffice. The electronics module contains a microprocessor-based controller to provide timing and sequential logic by use of software algorithms to control movement of liquids to and from the retort to process the specimens.

1-3-3 Solution sequence is as follows: Liquid from each of the first ten reagent reservoirs is sequentially drawn into the retort by a vacuum, and returned to the reservoir by positive air pressure. The same pump which provides the vacuum produces the air pressure. Successive solutions fix, dehydrate, and clear the processed tissues. After the last of these liquids is removed from the retort, molten paraffin is pulled into the retort to impregnate the tissues. A system of air valves and one liquid valve controls fluid movement. Following the removal of processed specimens from the retort, and pump-out of the paraffin, solvent is flushed back and forth from another reservoir to clean paraffin from the retort.

1-3-4 The actual completion time of processing is operator-selectable to permit all processing to be completed overnight. In this way, processing completion will coincide with the laboratory schedule for sectioning and staining of freshly prepared specimens. Processing times for each solution, including paraffin, are also operator-selectable by keyboard entry.

1-3-5 Heaters maintain the retort and the paraffin oven at precisely controlled temperatures. Specimens can be subjected to cyclic pressure/vacuum to pull entrapped air out and drive processing solutions into the specimens. The operator also has the option of having the retort heated or not heated during steps 1 through 10. Retort temperature is held at the temperature selected for each step. During steps 11 through 14 (11 through 13 in V.I.P. 3000) the retort can be programmed at temperatures from 45 °C to 70 °C. The oven will maintain temperature 3 °C higher than the mean retort temperature for stations 11 through 14 (11 through 13 in V.I.P. 3000).

1-3-6 Temperature sensors within the instrument monitor operation. In case of temperature malfunction the instrument is held in a STANDBY condition. Visible and audible alarms alert the operator.

1-4 DETAILS OF OPERATION

1-4-1 Rotary Valve.

The purpose of the rotary valve is to open a fluid path from a specific reservoir to the retort, and to stop flow of fluids into or out of the retort (all flow paths closed). In normal operation the valve has two positions for each of 16 stations open position and closed position. (**NOTE:** There is no station 14 in V.I.P. 3000.) In the open position the valve connects the retort to a reservoir so that solution pump-in or pump-out can take place. In the closed position fluids cannot flow to or from the retort. Operation of the rotary valve consists of rotation from an open or closed position to another open or closed position. The stations are numbered 1 through 16 in counterclockwise (CCW) rotation, as viewed from above. Station advance, is in the counterclockwise direction. The closed position for any station is CCW from its corresponding open position.

Program advance is accomplished in four operations.

1. CLOSE ROTARY VALVE. The valve rotates CCW from an open position to the nearest closed position.
2. OPEN ROTARY VALVE. The valve reverses (CW) to the open position.
3. STATION MOVE. The next station is selected. The valve moves beyond the open position of the next programmed station to the station's closed position, e.g. from station 3 open to station 4 closed.
4. STATION REVERSE. The valve reverses to the open position of the programmed station, e.g. from station 4 closed to station 4 open.

A positioning disc on the valve has openings which are detected by a photo diode transistor combination to identify station location and rotation stop points. A large opening in the disc signals the station, while a much smaller opening signals the rotation stop point.

1-4-1-1 The action of CLOSE ROTARY VALVE is as follows:

1. If the valve is in a closed position, it does not move.
2. If the valve is in or near the open position (including just open), it rotates CCW to the nearest closed position.
3. If the valve is near (but not at) the closed position, it reverses to the nearest open position before rotating CCW to the closed position.

Should the rotary valve fail to respond to the signal from the microprocessor, or fail to reach the required position, DIAGNOSE on the control panel will flash, and the operation will stop.

1-4-1-2 The action at OPEN ROTARY valve is as follows:

1. If the valve is in opened position, it will not move.
2. If the valve is in closed position it reverses to the open position.

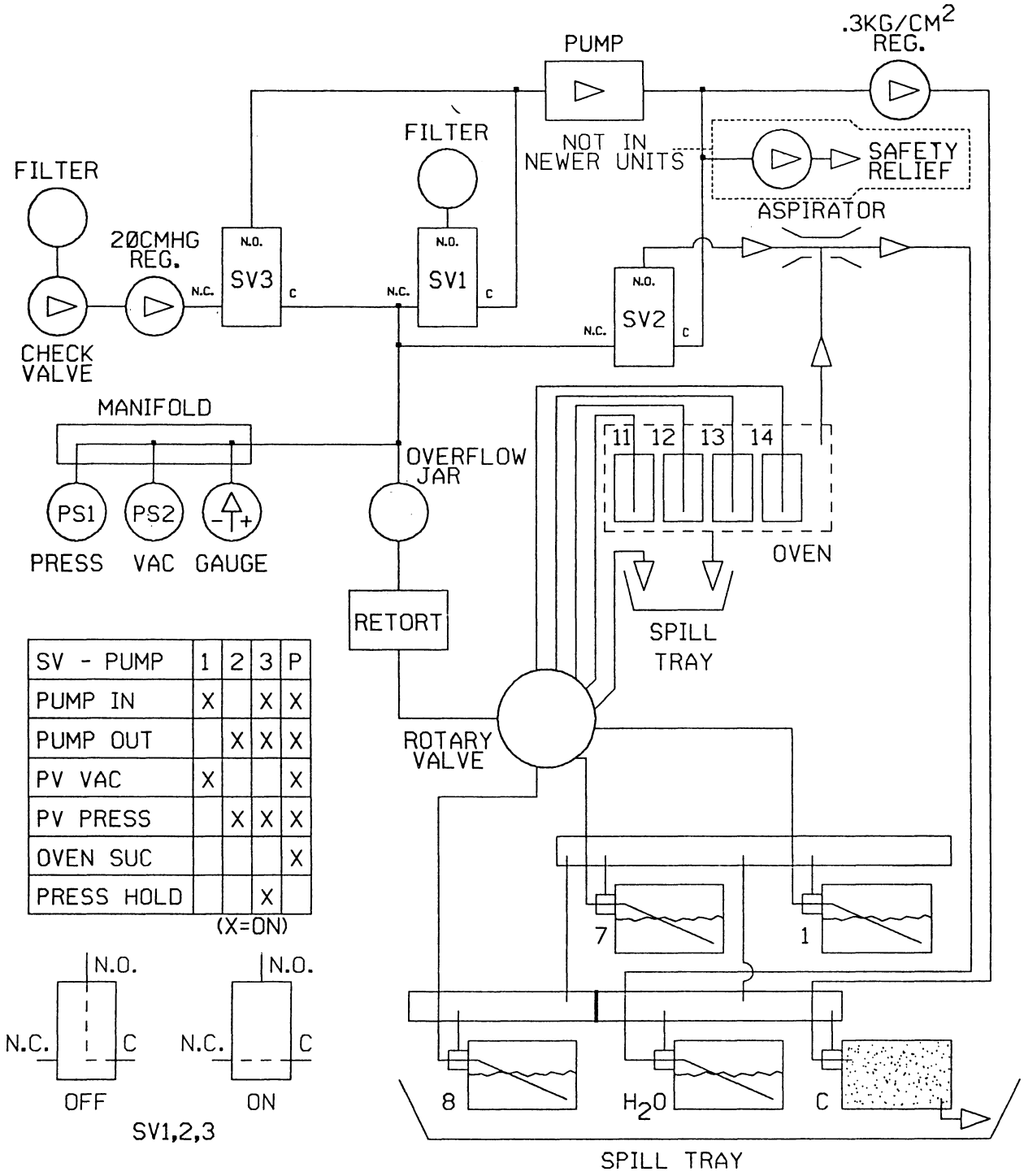


Figure 1-3. General Fluid Flow Diagram

3. If the valve has not fully rotated to the closed position, it advances to the closed position, then reverses to the open position.

Should the rotary valve fail to respond to the signal from the microprocessor, or fail to reach the required position, DIAGNOSE on the control panel will flash, and operation will stop.

1-4-1-3 STATION MOVE signifies that the valve rotates to the closed position of the next station. The action is as follows:

1. If the valve is in a closed position, it will not move.
2. The valve rotates CCW to the closed position of the next station in approximately 3.7 seconds (on 60 Hz line current).

   Exception: The move from station 12 to station 13 requires about 5 seconds.
3. When STATION MOVE is completed, the number of the next station is displayed on the control panel. The normal station increment is one.

Should an error occur, and the attained station not be the one programmed, operations 2 and 3, above, are repeated until the correct station is reached. In case the valve does not stop at the proper station after two complete rotations, DIAGNOSE on the control panel will flash, and operation will stop.

Should the valve not move from its starting position, (fail to respond to starting signal) or not fully advance to the next station, DIAGNOSE will flash, and operation will stop.

1-4-1-4 Notes on STATION MOVE operation.

1. If there is processing fluid in the retort when STATION MOVE commences, the reservoir for the attained station will be contaminated.
2. The rotary valve is heated to 70°C at all times. In case of power failure, paraffin may solidify in the valve. DO NOT USE FORCE to rotate the valve. Damage or malfunction can result. Check condition of paraffin in retort or oven to determine if cooling has occurred.

1-4-1-5 In STATION REVERSE the action is as follows:

1. The valve rotates to closed position. If it has stopped in a closed position, there will be no movement.
2. The valve rotates in reverse direction to the closed position of the previous station. The action is completed in approximately 3.7 seconds (60 Hz line current).

   Exception: Movement from station 13 to station 12 requires about 5 seconds.

Should the valve not move (fail to respond to starting signal), or fail to attain the required position, DIAGNOSE will flash, and operation will stop.

Notes 1 and 2 under STATION MOVE apply to STATION REVERSE also.

1-4-2 Pump-In.

PUMP-IN is the operation during which fluid from a reservoir flows into the retort.

With the rotary valve open, the pump will start, drawing air from the retort to produce a vacuum. See figures 1-3 and 1-4. The vacuum is maintained during solution transfer. When the reservoir has been emptied air is sucked into the reservoir and the vacuum level drops rapidly.

The pressure sensing switch, PS2, senses this decrease in vacuum, and signals the rotary valve to close. When the valve is closed, the pump stops.

1-4-2-1 Sequence of Operations.

NOTE: PUMP-IN will not take place at stations 11 through 14 unless all of the following conditions exist:

a. The temperature of the retort has reached the set temperature selected by the operator.
b. The paraffin in the oven is molten.
c. The temperature of the rotary valve is higher than 70°C.

Operating sequence is described below.

1. The rotary valve is opened, connecting the retort to the required reservoir.
2. Solenoid-operated valves SV1 and SV3 and the pump are activated to produce vacuum in the retort. The PUMP-IN indicator illuminates. Solution flow is gradual.
3. When pressure in the retort goes lower than 14 cm Hg, vacuum-sensing switch PS2 turns off, while pressure reduction continues to 20cm Hg at which point relief valve 1 operates. PS2 is set to turn on at pressures higher than 12cm Hg and turn off at pressures lower than 14cm Hg.
   Normally PS2 will turn off within 10 to 20 seconds after the pump-in has started. If it does not turn off within one minute, operations specified in paragraph 1-4-2-2, a and b, are initiated automatically.
4. Vacuum-sensing switch PS2 remains off until the reservoir is empty, at which time air being drawn into the retort raises the pressure level in the retort rapidly to greater than 12cm Hg, causing PS2 to turn on.
   If PS2 does not turn on within 6 minutes after the pump has started, the fault may be clogged tubing. DIAGNOSE will illuminate (E-11). In this case, PUMP-OUT will be performed and operations 1 through 5 will be repeated up to three times.
   Should PS2 fail to turn on after three repetitions (6-minute cycles), DIAGNOSE will flash and the buzzer will sound for 30 seconds (E-12).
5. With PS2 in 'on' condition, the rotary valve closes to retain the solution in the retort. The pump turns off when the rotary valve begins to close. Solenoid-operated valves SV1 and SV3 and PUMP-IN indicator turn off immediately after the valve is completely closed. This completes PUMP-IN. The

following operations are automatic corrective actions in case of failure of timely closure of PS2 in operation 3, above.

1-4-2-2 Automatic Corrective Operation.

a. If negative pressure lower than 14cm Hg is not attained in the retort one minute after the pump has started, and PS2 does not turn off, operation will stop, and the rotary valve will close.

b. Activating the pump and solenoid-controlled valves SV2 and SV3 with the rotary valve closed will pressurize the retort.

If pressure sensing switch PS1 turns on within one minute after pressurizing starts, it is probably because of an empty reservoir, defective paraffin pot O-ring, or retort lid sealing problem. Should this occur during automatic processing after PUMP-OUT has been performed the rotary valve returns to the previous station. Solution is pumped into the retort, and operation stops. After operation stops, FLUID LOW indicator flashes and the buzzer sounds for 30 seconds. DIAGNOSE illuminates but does not flash (E-14). If the pressure sensing switch (PS1) does not turn on within one minute after the retort is pressurized, operation will stop. DIAGNOSE will flash (E-13) and buzzer will sound.

1-4-2-3 Retort Overflow. The following operations are performed in case of retort overflow. During pump-in, air is sucked out of the retort via the overflow trap. If solution enters the trap, it will be sensed by the capacitance proximity switch, which is mounted external to the trap.

a. If overflow of the retort is sensed during PUMP-IN, the pump stops and the solenoid-operated valv SV1 closes immediately, allowing the retort to return to atmospheric pressure. The pump and solenoid-operated valves SV2 and SV3 operate for 15 seconds to return solution in the trap to the retort. Solution is partially returned to the reservoir.

b. The rotary valve closes after the 15 second pump-out, DIAGNOSE flashes and the buzzer sounds for 30 seconds (E-10).

1-4-2-4 Notes On Operation.

1. If the retort interlock is released during pump-in, the pump and the rotary valve will stop. The solenoid-operated valve SV1 will close. When the retort is again locked, solution in the retort will be pumped out, and pump-in will begin again.
2. In the case of the upper reservoirs in the counter-top model, which are above the retort, solution will continue to flow to the retort if a power failure occurs during pump-in. Conversely, in the floor model, where all reservoirs are below the retort, solution will flow back to the reservoirs. When power is restored, pump-out will be performed; then pump-in will start again.

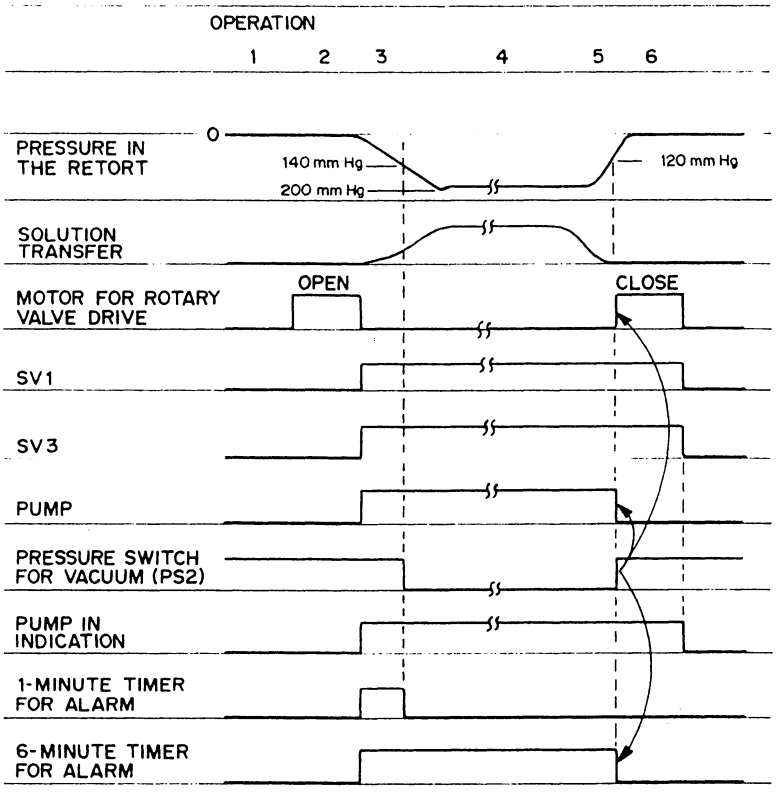


Figure 1-4. Timing Chart, Pump-In

1-4-3 Pump-Out.

PUMP-OUT is the operation during which fluid is returned from the retort to the reservoir. See figures 1-3 and 1-5. With the rotary valve closed, activating the pump pressurizes the retort.

When the valve is opened, the pressure will force the liquid into the reservoir.

When all liquid has been returned to the reservoir the pressure in the retort drops, since air is being discharged via the reservoir. The pump stops. PUMP-OUT is completed.

1-4-3-1 Sequence of Operations.

NOTE: At stations 11 through 14 PUMP-OUT will not be performed unless all of the following conditions exist.

a. The temperature of the retort has reached the set temperature selected by the operator.
b. The paraffin is molten.
c. The temperature of the rotary valve is above 70°C.

If one of the above conditions does not exist, the instrument will be in a standby mode. STANDBY will flash on the control panel.

Significance of STANDBY Flashing. STANDBY flashes if the temperature of the paraffin oven drops below the prescribed temperature. This may be caused by the addition of cold paraffin to the pots, or power failure. Instrument operation is suspended until the oven temperature rises to the programmed level. The chart below shows instrument operation delay contingent on oven temperature discrepancies.

Table 1-1. Relationship of Temperature to Processing Delay

Retort (Station 11 through 14)

Retort Temperature	Waiting Period
more than 5°C lower than the preset temperture	1 hour
more than 7°C lower than the preset temperature	1.5 hours
more than 9°C lower than the preset temperature	2.5 hours
more than 11° than the preset temperature	3.5 hours
more than 13°C lower than the preset temperature	4.5 hours
more than 15°C lower than the preset temperature	5.5 hours
more than 17°C lower than the preset temperature	24 hours

Oven (Station 1 through 10, 15 and 16)

Paraffin Oven Temperature	Waiting Period
more than 13°C lower than the preset temperture	20 minutes
more than 15°C lower than the preset temperature	1.5 hours
more than 17°C lower than the preset temperature	2.5 hours
more than 19°C lower than the preset temperature	3.5 hours
more than 21°C lower than the preset temperature	4.5 hours
more than 23°C lower than the preset temperature	24 hours

Operating sequence is described below.

1. At start of PUMP-OUT, the rotary valve will be in or move to the closed position.
2. Solenoid-operated valves SV2 and SV3 and the pump activate to pressurize the retort. PUMP-OUT indicator illuminates. If any electrical noise is detected by the control system within one second after start, the timer will reset, and the operation will begin again. When pressure in the retort exceeds 0.2 kg/cm² the pressure-sensing switch (PS1) turns on.

   PS1 should turn on within 10 to 20 seconds after the pump is activated. If it does not turn on after one minute has elapsed, DIAGNOSE will illuminate but not flash (E-20). The pump stops and solenoid-operated valves SV2 and SV3 close. Pressure in the retort returns to atmospheric. This condition will prevail 15 seconds, after which the process is repeated as described in 1 and 2, above.

   If PS1 does not turn on after 3 repetitions of the above sequence, the pump will stop, SV2 and SV3 will close, DIAGNOSE will flash and the buzzer will sound for 30 seconds (E-21).
3. The rotary valve moves to open position one second after retort pressure reaches 0.2 kg/cm², allowing liquid to be forced back into the reservoir.
4. Positive pressure (0.3 to 0.35 kg/cm²) is maintained in the retort during solution transfer. When all solution has been returned to the reservoir, pressure in the retort drops rapidly, and PS1 deactivates after the pressure drops below 0.15 kg/cm². The solution transfer time is about two liters per minute.

   If solution transfer is not completed within six minutes after start, the pump will stop, SV2 and SV3 will close, DIAGNOSE will flash (E-22). Pressure in the retort will return to atmospheric. After 15 seconds the sequence is repeated, starting with 1, above. If a second failure is detected, the pump will stop, SV2 and SV3 will close, DIAGNOSE will flash (E-23), and the buzzer will sound for 30 seconds.
5. If no error has been detected, the pump, SV2, and SV3 remain activated for 3 seconds after the pressure-sensing switch, PS1 turns off. The purpose of this action is to clear the retort walls and tubing

of solution. Air is forced through the reservoir to produce the pressure drop described in 4, above.

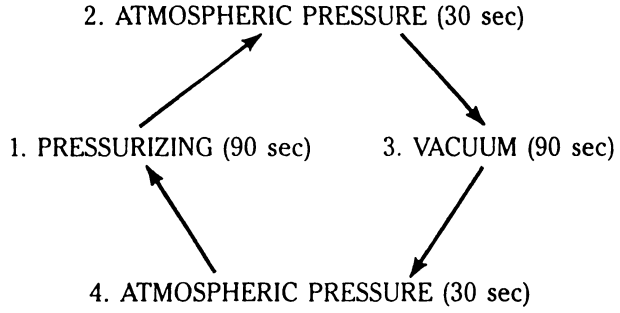
6. When the pressure drop is detected by PS1, the pump, SV2 and SV3 are deactivated, and the rotary valve closes. The illumination of PUMP-OUT display extinguishes. Pump-out operation is completed.

1-4-3-2 Notes On Operation.

1. If the retort interlock is released during pump-out, the operation stops. When the interlock is again closed, the operation will start again at 1, above.
2. In case of power failure during pump-out, liquid in a reservoir higher than the retort (upper reservoirs of counter-top model) will flow back to the retort. Conversely liquid will continue to flow into reservoirs below the retort (lower reservoirs of counter-top model, and all reservoirs of floor model). When power is restored, the pump-out sequence will restart at 1.
3. If any solution except paraffin has entered the overflow trap during pump-in, it will have no effect on pump-out operation. Almost all solution will be returned to the retort from the trap.
4. The timing of pump-out operations is shown in Figure 1-5.

1-4-4 Pressure/Vacuum Cycle.

At certain periods during processing of specimens, a pressure/vacuum cycle is introduced. The cycle is illustrated below.



The cycle always begins with pressurizing, and is repeated according to the total time programmed per station.

1-4-4-1 Operating Sequence.

1. The rotary valve is closed. Pump and valves operate as in pump-out until positive pressure reaches 0.2 kg/cm². Five seconds after PS1 turns on the pump stops. The retort pressure will be held

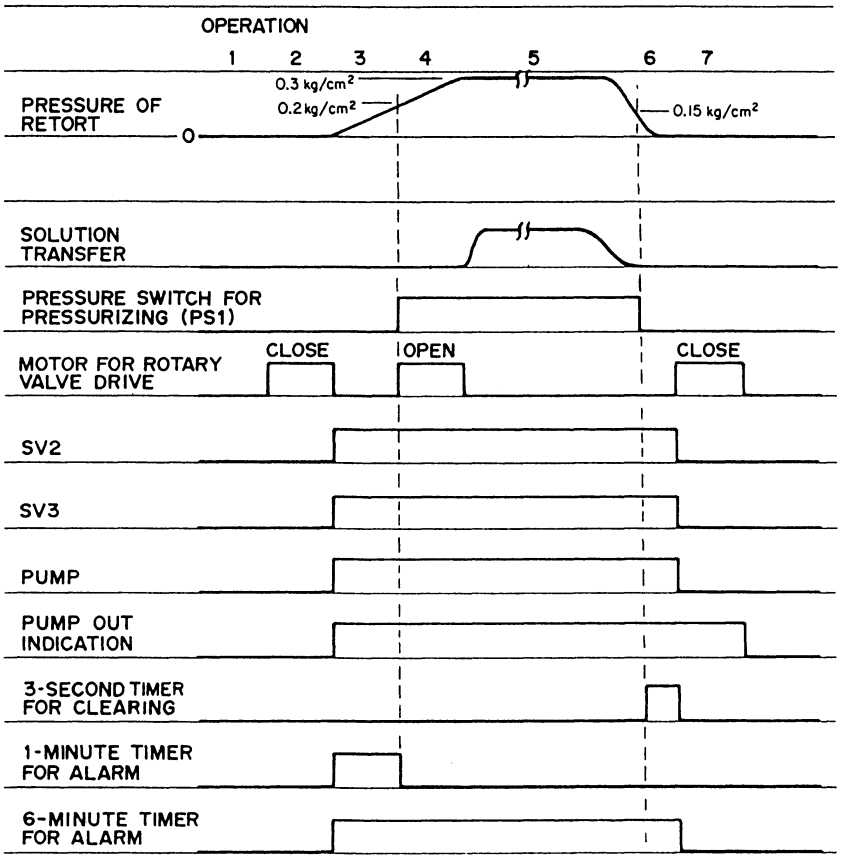


Figure 1-5. Timing Chart, Pump-Out

*Safety valve was used only one some older models

at approximately 0.3 kg/cm² for the remainder of the pressurization time. If the pressure drops below 0.15 kg/cm² the pump will again start to pressurize as in paragraph 1 above.

2. After 90 seconds the retort returns to atmospheric pressure for 30 seconds.
3. The rotary valve remains closed. Pump and valves operate as for pump-in, except that solenoid-operated valve SV3 does not open and relief valve 1 is not operated. Negative pressure in the retort will reach 50 to 60cm Hg.
4. After 90 seconds, pumping stops and the retort returns to atmospheric pressure for 30 seconds. Should the overflow sensor be activated for any reason during vacuum pumping, solution in the trap will be returned to the retort by automatic switching to the pressurizing phase. If the solution is returned to the retort, the P/V cycle will continue.

   If solution is not removed from the trap by pressurization, processing will stop, DIAGNOSE will flash, and buzzer will sound for 30 seconds (E-01).

1-4-4-2 Over-pressure Protection During Pressurizing Cycle. If the relief valve does not function at 0.35 kg/cm² during pressurization, excessive pressure could build up in the retort. To prevent this condition, a safety valve which operates at 0.7 kg/cm² is connected to the pressure side of the pump.*

The complete pressurizing cycle is 90 seconds. However, if pressure in the retort reaches 0.7 kg/cm² within 10 seconds after the pump starts the safety valve will open.* If the relief valve is operating properly, at 0.35 kg/cm², solenoid-operated valve No. 3 will close to maintain pressure and the pump will stop five seconds after PS1 turns on. If pressure drops, the pressure-sensing switch, PS1, will restart the pump. In this manner the required pressure is maintained.

An advantage of this intermittent operation of the pump is the reduction of the quantity of paraffin vapor being drawn from the oven. Pressurizing air is drawn from an inlet above the oven.

The safety valve also protects against excessive pressures which could be caused by a clogged solution line from the retort during pump-out.*

1-5 TEMPERATURE CONTROL

Temperature control is provided for the retort, the oven, and the rotary valve. The microprocessor will detect any failure of the controls and provide an error display. A thermistor serves as the temperature sensor.

Temperature of the retort or the oven can be displayed on the control panel. Temperature of the rotary valve, which is controlled at 70°C ± 2°C at all times, is not displayed. Temperature is controlled during the following operating modes:

1. Automatic Processing
2. Cleaning Cycle
3. Manual Operation
4. Other than 1, 2, or 3

1-5-1 Automatic Processing.

Temperature is controlled at the levels set for each station at time of programming.
(35°C to 50°C for stations 1 through 10; 45°C to 70°C for stations 11 through 14; or stations 11 through 13 in V.I.P. 3000.)

If the delay timer is in use, the retort will not be heated until the delay time has elapsed, and processing begins at station 1.

Releasing the retort interlock during automatic processing does not interrupt temperature control.

If the programmed temperature is to be changed during processing:

1. Release retort interlock.
2. Program new temperature.
3. Close retort interlock.

1-5-2 Temperature Control During Cleaning Cycle.

The retort temperature at station 15 (xylene cycles) is factory set at 65°C for the first five xylene cleaning cycles. During the last four cycles the retort is not heated. The retort is not heated at station 16 (alcohol cycle).

1-5-3 Temperature Control During Manual Operation.

When manual operation is initiated, for example, by opening the retort interlock during automatic processing, the temperature selected for the station will be maintained. Retort temperature control will stop when:

1. The station is changed in the range of 1 to 10, or 16. Control at stations 11 through 14 (11 through 13 in V.I.P. 3000) will not be affected.
2. When a new temperature is keyed in, the temperature will be controlled at the new setting.
3. When no heating is keyed in, heating at stations 11 through 14 (11 through 13 in V.I.P. 3000) cannot be cancelled.

   Under other conditions the temperature at stations 11 through 14 (11 through 13 in V.I.P. 3000) will always be maintained at the programmed temperatures. The program can be changed within limits stated in the operator's manual.

1-5-4 Temperature Display.

The range of temperature display is 0°C to 99°C. Temperatures lower than 0°C or higher than 99°C will be displayed as 0°C and 99°C respectively. The display is accurate to within ±1°C. Accuracy of the controlled temperature is ±2°C with reference to programmed temperature.

*Safety valve was used only on some older models.

1-5-5 Retort Temperature Control.

A resettable thermal cutout and a thermal fuse, in series with the heater provide protection against overheating.

The cutout will trip at 80°C. If the cutout opens, a photo-coupler in parallel with it will activate, signalling the microprocessor. At a predetermined time 102 seconds after the cutout trips, DIAGNOSE will flash (E-30).

The thermal fuse will open at 97°C, and must be replaced if opened. No fault detecting circuit is associated with this fuse. There will be no error display if this fuse opens. This should not present any problems in most cases, since the cutout should trip well below the opening temperature of the fuse.

1-5-5-1 Alarm. If temperature continues to rise 15 minutes after the heater receives a turn-off signal, DIAGNOSE will flash. Since heat from the oven also heats the retort, even though the retort is set for no heat, DIAGNOSE will not flash until retort temperature exceeds 50°C.

About 15 minutes is required to detect temperature control malfunction. If continuous heating is caused by a defective triac, the thermal cutout may trip before fault detection. In this case DIAGNOSE will flash, but the corresponding error code (E-38) will not be displayed when called for.

If temperature continues to fall 15 minutes after the heater receives a turn-on signal, DIAGNOSE will flash.

1-5-5-2 Thermistor Malfunction. If the thermistor opens, DIAGNOSE will flash 102 seconds after opening. The temperature display will be 0°C. If the thermistor is shorted, temperature display will be 99°C.

If temperature display is 99°C when the retort is cold, a shorted thermistor is indicated.

1-5-6 Parraffin Oven Temperature Control.

Heating of the oven is continuous as long as the main power switch is on.

The temperature maintained in the oven is 3°C above the mean value of temperatures set for the retort at stations 11 through 14 (11 through 13 in V.I.P. 3000). Retort temperatures for these stations will be automatically selected even if they are not used (processing time programmed 00:00).

NOTE: At initial turn-on of the processor, a retort temperature of 60°C is automatically selected for stations 11 through 14 (11 through 13 in V.I.P. 3000).

If the retort temperature is changed in stations 11 through 14 (11 through 13 in V.I.P. 3000) by programming operation, the oven temperature to retort temperature relationship remains the same.

1-5-6-1 Overheat Protection. Overheat protection is the same as for the retort as described in paragraph 1-5-5.

1-5-6-2 Alarm. Alarm characteristics are the same as for the retort described in paragraph 1-5-5-1.

1-5-7 Rotary Valve Temperature Control.

The rotary valve is maintained at 70°C at all times, regardless of automatic or manual operating mode.

1-5-7-1 Overheating Protection. Overheating protection is the same as for the retort described in paragraph 1-5-5.

1-5-7-2 Alarm. Alarm characteristics are similar to those for the retort, except that there is a high limit of 80°C which will cause DIAGNOSE to flash after 15 minutes elapse.

NOTE: There is no display of the rotary valve temperature.

1-6 CIRCUIT DESCRIPTION

1-6-1 Introduction.

The V.I.P-1000/2000/3000 Vacuum Infiltration Processors are controlled by a microprocessor based computer control unit. The overall block diagram of the electronic control system is shown in Figure 1-6.

The heart of the microprocessor-based computer control unit is the Z80, 8 bit microprocessor. This microprocessor is constructed using MOS LSI technology. The Z80 microprocessor, including the other components in the set, is superior in both software and hardware capabilities to any other 8 bit micro computer system in current use. The operating system for the processor is contained in three EPROM devices having a total of 12K bytes of memory storage. The user-entered programs, together with interrupt information, is stored in the 2K byte RAM memory. (Newer units provide storage capacity of 32K bytes in EPROM and 8K bytes in RAM.) The system clock frequency in this application is 2.5 Megahertz.

The input line voltage for the various models within the V.I.P-1000/2000/3000 family can be 100 volts, 115 volts, 220 volts, or 240 volts. The power ON switch device is a circuit breaker combination leakage detector. This circuit breaker serves to limit the power line to line current to 15 amperes as well as limiting line to ground leakage current to 30 milliamperes.

Figure 1-6 shows that the line current, after leaving the circuit breaker, enters the heaters which heat the rotary valve, retort, oven and a retort overflow tube heater. A self-impedance, controlled heater is used to heat the stainless steel tube leading from the retort to the overflow bottle.

The heaters are controlled by Triac switches (TRC1, TRC2 and TRC3) which are mounted on the metal chassis' wall in the electronic control box. The 115 volt line current is then fed to a step down transform

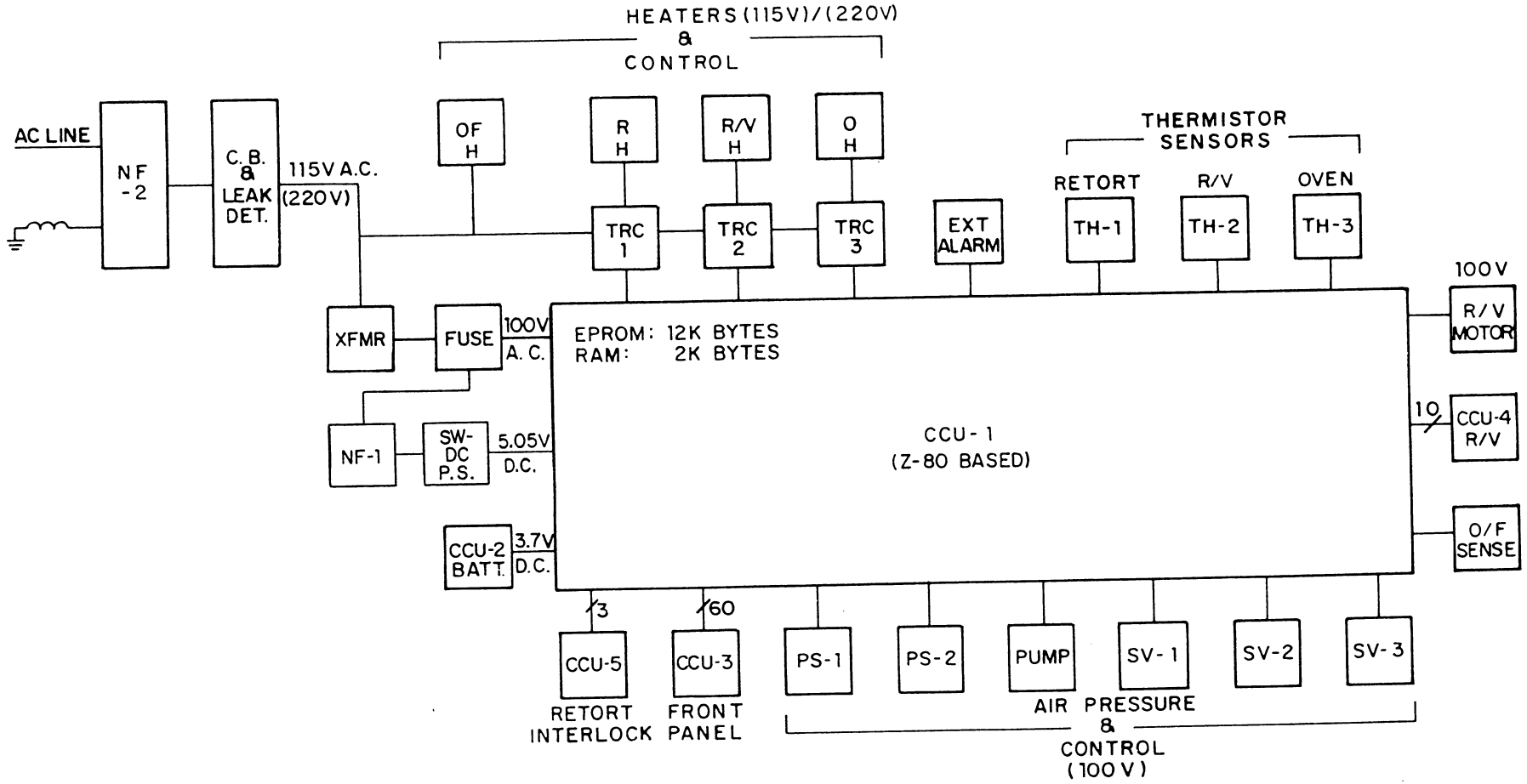


Figure 1-6. Electronic System Block Diagram

(XFMR), which is used in all models except the 100 volt model. There are two different transformers for the 100/115 and 220/240 volt units; the transformer secondary circuits are protected by a cartridge type fuse which is mounted inside the electronics control box.

Two line filters are provided to limit power line noise transients from interfering with the microprocessor controller. The noise filters are labeled NF-2 and NF-1. The NF-2 filter is located at the input of the ac line to the control box. In addition, an inductance is connected from the ground termination at the noise filter to a chassis point. This grounding inductance additionally limits line to ground transients from interfering with the microprocessor operation. The second noise filter, NF-1, is located at the output of the transformer at the 100 volt ac level.

The computer control unit (CCU-1) has four different voltage levels on the printed circuit board itself. These levels are 100/115 or 220/240 volts ac for control of the heaters in the system, 100 volts ac which is used for the control of a variety of other sensor components or control components which will be specifically defined in later paragraphs, 5.05 volts dc from the output of a switching type power supply, and approximately 3.7 volts dc from a lithium back-up battery on printed circuit board CCU-2.

The temperature of the various compartments that are heated in the V.I.P are sensed by three thermistor type sensors labeled TH-1, TH-2, and TH-3.

The air pressure and control system components are powered by the 100 volt ac voltage and includes the positive pressure switch PS-1, negative pressure switch PS-2, the fluid overflow sensor, the air pump, and three solenoid valves SV-1, SV-2, and SV-3 which determine if the retort is to be subjected to either positive pressure or to negative pressure (vacuum). The main fluid control valve is a rotary valve and is actuated by a low speed, synchronous, stepper type motor. The motor is connected to the 100 volt ac supply through a solid state type relay. CCU-4 is a printed circuit board containing opto-electronic type position sensing devices to determine the rotary valve position. The retort interlock slide position is sensed by an opto-electronic device located on printed circuit board CCU-5.

The main computer control unit is connected to the front panel display printed circuit board, CCU-3, by a 60 conductor ribbon type cable. The front panel printed circuit board contains the keyboard information entry and control system, the 7 segment LED numerical display devices, the processor control button, the 7 segment LED program number display device, and several integrated circuits which serve as drivers for the variety of LED back lighted display indicators and as decoders for display device selection.

The remaining input device to the computer control unit is the overflow sensing device which is a capacitance type proximity sensor. This sensor senses the fluid level in the overflow bottle which is connected to the air line system that pressurizes or evacuates the retort.

The electronics control unit is basically the same for all voltage models. The basic differences in voltage models from the 100/115 volt system to the 220/240 volt system are the wattage of the heaters in the system, and the step down transformer to 100 volts.

1-6-2 Computer Control Unit (CCU-1).

Figure 6-1 shows the schematic of the computer control unit. All connection points to other printed circuit boards and input/output (I/O) components are included in oval outlines and are labeled for instance, C1-39. This schematic contains only the components appearing on CCU-1, except for a simplified diagram of the printed circuit board front panel, CCU-3, used to indicate the I/O connections to the key pad together with one of the decoder integrated circuits (74LS145).

In the lower left hand corner of the diagram the connections are shown for the various connectors with respect to plus 5.1 volt dc which is referred to as Vcc and the ground for this supply.

The main complement of microprocessor control chips is the CPU; the four PIO chips which are designated PI01, PI02, PI03, and PI04; the CTC chip; the three EPROM chips, ROM1, ROM2, ROM3; the RAM chip; and an 8 bit I/O port chip IC5. The microprocessor chip set is connected in a conventional fashion. The data bus is labeled D0 to D7 and the address bus labeled A0 to A15.

The basic voltage turn on reset circuitry is contained in the upper left hand portion of Figure 6-1. After the circuit breaker is turned ON, the output voltage, Vcc, of the switching regulator is applied to IC3 which is configured as a programmable, adjustable voltage reference with hysteresis. A time delay is provided by R6 and C1 in order to allow the Vcc voltage to be stabilized on all components in the electronic control system. After Vcc stabilization, a positive voltage will appear at pin 4 of IC17 and consequently will provide the RESET pulse to the microprocessor to perform the "turn-on" reset function. If improper system operation requires a MANUAL reset, the RESET pulse to the microprocessor system can be entered by use of SW2. Switch SW2 is located on the CCU-1 printed circuit board.

The primary purpose of IC3 is to provide a fixed voltage reference used to detect a loss of power supply voltage. The thresholds indicated are 4.8 and 4.9 volts. When the power has been interrupted to the system, the Vcc voltage will decrease. When the thresholds are reached, the voltage level will change at pin 11 of IC17, this voltage change will trigger a $\overline{\text{NMI}}$ signal to interrupt the microprocessor; sufficient time is allowed for transfer of the program counter and system constants to the RAM memory chip.

The pulse that creates the $\overline{\text{NMI}}$ will also serve to interrupt the Vcc supply which is connected to the RAM chip through TR1; upon Vcc interruption the RAM c

will be powered by the battery Li. In series with the battery Li is a switch, SW1, which is located on CCU-2. IC4 is another programmable voltage reference which is programmed by the fixed resistive divider string R9, R10, and R11 located in parallel to the battery Li. When the battery voltage drops below approximately 2.3 volts the output of IC4 will go high and provide a signal through C1-30 to CCU-3 to turn the decimal points ON on all the 7 segment display devices (with the exception of LED-9). Of course, if switch SW1 is opened the decimal points will also be turned ON.

The basic system clock for the microprocessor control chip is generated by inverters IC6, IC7, and IC8. This crystal controlled, feedback oscillator forms a square wave with a frequency of 2.5 Megahertz at pin 9 of IC-7. This generator is the basic clock input for the microprocessor controller.

The basic operating system is stored in the ROM 1, 2, and 3 chips which are 4K by 8 Erasable Programmable Read Only Memories. Integrated circuit IC9 serves as a dual, two line to four line decoder for selecting the memory chip locations for operating program usage. IC13 functions as a three to eight line decoder to select the CTC (Z-80 Counter Timer Controller) or either one or more of the four PIO chips.

Integrated circuit IC-24 is a basic 555 timer circuit. It generates a 1.0 Kilohertz pulse train. This pulse train is used to periodically deliver a $\overline{\text{BUSQR}}$ request to the CPU chip. The 1.0 Kilohertz pulse train is also applied to IC-7 which functions as a binary counter for sequencing of the 7 segment LED display devices located on the front panel. The continuous, repeatable sequence is delivered through IC-8, a hex bus driver with switchable tri-state outputs, to the A0, A1, and A2 address lines of the CPU. Additional information on the performance on this portion of circuit will be included in the description of the front panel indicators.

The various timing signals for station processing times, the real time clock and other timing functions within the system are controlled by the Z-80 Counter Timer Circuit (CTC). The CTC consists of four independently programmable counter timer channels each with a readable down counter and a selectable 16 or 256 prescaler. The down counters are reloaded automatically at 0 count. IC-29 is a self contained, crystal controlled, oscillator generating a square wave pulse train with a period of 8 milliseconds. In this application the output of IC-29 is connected to two of the clock trigger inputs of the signal channels available. In addition, another count-down is performed to create a pulse train with a period of 6.6 microseconds for the clock input to the analog to digital converter IC-1. This pulse train is squared up by IC-12 which is a dual JK flip-flop with clear control.

The compatible interface between peripheral devices and the Z80-CPU microprocessor is handled by four parallel input/output controllers labeled PIO-1 through PIO-4. These devices have capability for bus addressing as well as 8 bit parallel data transfer. The system function of PIO-1 will be explained first.

The two functions that are handled by PIO-1 are the input of digitized temperature sensor information and heater on/off control signals for the retort, rotary valve and oven.

The device IC-2 is used as a voltage convertor to generate a negative 5 volt dc level for the dual-slope integrating analog to digital convertor (ADC) IC-1. IC-1 is a 12 bit ADC which provides digitized temperature sensor information from analog voltages generated by TH1, TH2, and TH3, which are the retort, valve and oven thermistor temperature sensors, respectively. These three temperature sensors are supplied with a constant dc voltage of 0.7 volts obtained from the diode D3 in series with R3 connected to the +5 volt supply. The reference input voltage for the ADC is determined by the resistive divider R25 and R26. This reference voltage is connected to the minus reference input on pin 39 of IC-1. The basic positive reference provided by the diode D3 is applied to pins 35 and 36 of IC-1. Each one of the temperature sensing thermistors operates in a bridge circuit with either R22, R23, and R24 and the R25, R26 series combination.

The analog thermistor voltages are connected to pins 13, 14 and 15 of IC-18. This device is a 3 channel multiplexer sequenced by signals at pins 10 and 11 which are connected to the address bus A6 and A7 of PIO-1. The multiplexed analog voltage levels appear at the COM output, pin 3, of IC-18 and are connected to pin 34 of IC-1. The digitizing occurs within IC-1 and the output appears on the parallel data bus B1 through B12 which in turn is connected to the 8 bit B port of PIO-1. The 12 bit data word plus overange (OR) and polarity (POL) bits is handled in two bytes controlled by $\overline{\text{HBEN}}$ and $\overline{\text{LBEN}}$.

A portion of the A port of PIO-1 is used as a control output for controlling the on/off status of the three heater systems within the instrument. The ports A3, A4, and A5 are respectively the control ports for the oven, valve and retort heaters. The control signals are connected to the quad, 2 input-NOR gate IC-14 with an output signal obtained from PC-1. PC-1 is a photocoupler which is used to indicate the presence of the line voltage connected to the individual system heaters. If the line voltage is present and a signal is provided to turn on an individual heater then the individual heater indicators on the printed circuit board will illuminate. The printed circuit board LED's D5, D6 and D7 respectively indicate a heater ON condition for the oven, valve, or retort heaters.

The LED devices, D5, D6, and D7 are driven by individual transistor drivers contained in the transistor array TR3. The outputs of TR3 serve a dual purpose in not only controlling the heater-ON LED devices but also to control PC5, PC6, and PC7 which are the photo thyristors used to switch the heater control triacs for the retort, rotary valve, and oven heaters respectively.

Photocouplers PC1 and PC2 are the manual, thermal over temperature protector sensing couplers. The input to each photocoupler is connected across the series string consisting of the triac, the 96°C fusable link, and the heater in each one of the three heater circuits. In this configuration the photocoupler is normally conducting and the red LED fuse indicator diodes D8, D9 and D10 are not illuminated. If a problem occurs with over temperature then the photocoupler will switch to a non-conducting state and a red LED will illuminate. TR4 functions as a multiple transistor driver for the LED indicators. In addition, the three-input NOR gate IC-19 consolidates thermal fuse indicator signals and the output is connected to the B0 input of PIO-2. This signal will be utilized in the microprocessor controller to indicate a thermal malfunction which will be stored in the DIAGNOSE segment of RAM memory.

The next PIO device to be defined is PIO-4. This device is connected and programmed in the output mode for both ports. In addition, lines B0, B1 and B2 are used as decoder outputs for the front panel display selection system. The remainder of the lines A0 through A7 and B3 through B7 provide control of the basic LED back-lighted panel indicator devices on the front panel printed circuit board.

The PIO device PIO-3 is used essentially as an input device. Lines B0 through B3, A0, and A1 are used to input rotary valve position information obtained from the LED position sensing devices located on the rotary valve printed circuit board. Lines B0 through B3 input signals 1, 2, 3, and 4 to set-up the station location code. This code is displayed on green LED devices D15 through D18 which are driven by individual transistors in the TR6 transistor array. Inputs A0 and A1 are connected to two LED position detectors that sense open and closed positions on the rotary valve positioning ring. These two signals also pass through transistor array TR6 and illuminate green LED's D19 and D20.

Line A2 receives the input from the temperature display select switch on CCU-3. This switch selects the oven temperature for display instead of the retort temperature. Lines A3 through A7 input the signals from the keyboard switches as well as the MANUAL, START, and PROGRAM inputs from CCU-3. Lines B4 through B6 are the switch matrix selection output signals for the 74LS145 decoder/drivers. Line B7 actuates the audible buzzer which is located on CCU-3.

The remainder of the inputs and outputs to the microprocessor-controlled system are connected to device PIO-2. Port connections A0 through A6 provide the control signals for the solid state relays SR1 through SR7. These solid state relays control the air pump, SV1, SV2, SV3, the clockwise rotation of the rotary valve, the counterclockwise rotation of the rotary valve, and the external alarm control. Yellow LED's D22 through D28 indicate the presence of actuating signals applied to the solid state relays. These signals are connected to transistor array TR5 and also to the hex buffer/driver control device IC-16. When the Retort Interlock signal appears at C4-2, then control inputs on pins 1 and 15 of IC-16 will disable the rotary valve, solenoid valves SV1, SV2, SV3, and the air pump. Device IC-15 functions as an exclusive OR device that prevents simultaneous selection of both clockwise & counterclockwise rotation of the rotary valve. The series R-C devices SK1, SK2 and SK3 are used as transient suppression devices to limit turn-off transient voltage levels from causing electrical problems in the solid state relays SR1, SR5, and SR6.

Line A3 applies a signal to CCU-3 via C1-10 to indicate that the pump is off. Line A7 is the ON indicator signal if the oven temperature is selected for display by a signal on line A2 of PIO-3.

Lines B1, B2 and B3 are the inputs for the signals originating at the overflow sensor, the positive pressure sensing switch PS1 and the negative pressure sensing switch PS2 respectively.

The pressure switch signals are also connected to CCU-3 via connections C1-11 and C1-12 for display. The line B4 connects the blinking colon information to CCU-3. Line B5 is the input signal from CCU-5 to indicate that the retort interlock slide is in the closed position; this status is indicated by the green LED D14. The status of the overflow sensor, PS1, and PS2, is indicated by the green LED diodes D11, D12, and D13 which are driven by transistor array TR4.

Device IC-5 is an 8 bit data port. The outputs D01 through D08 are connected to CCU-3 and will be discussed in more detail in the next section.

This completes the description of the microprocessor controller printed circuit board.

1-6-3 Front Panel Printed Circuit Board (CCU-3).

The entire operator control function is shown on schematic Figure 6-2. The majority of the devices shown on this schematic are transistor drive arrays and seven-segment, light emitting diode display devices. There are three integrated circuits on CCU-3 which serve as decoder and selector devices.

Devices TR7, TR8, TR9, TR10, and TR11 are transistor arrays that are used to provide drive signals for the LED blocks to back-light the printed system functions such as PRESSURE, RELIEF, VACUUM, START, CLEAN, DRAIN, etc. or for selection of the proper display device segment on the date, hour, minute, and temperature LED display devices. In addition, pin C1-30, which is connected to TR8, will display the decimal points on LED displays 1 through 8 in the event of a low battery voltage or if switch SW1 is open. Switch SW1 is located on the CCU-2. The START, CLEAN and DRAIN function displays are controlled by signals from pins 4 and 7 of IC-32. In addition, the remaining output lines from pins 1, 2, and 3 of IC-32 control the pump-out, pump-in, and PV cycle displays. As such, IC-32 functions as a 3 bit binary to octal decode for display selection purposes.

Device IC-33 serves as the matrix coding device for the keyboard switches located on the front panel. In addition to the functions located on the keyboard itself, the reed switch actuated controls MANUAL and PROGRAM are also connected to the selection matrix. The other switch that is connected to this matrix is the START, DRAIN, CLEAN push button.
The continuous sequencing of the seven-segment LED display devices is controlled by signals at CI-54, 55 and 56. These signals are connected via inputs A, B and C on the integrated circuit IC-34 which is used as a 3 to 8 line decoder. These outputs are utilized in a time-multiplex fashion to illuminate either LED 1 through 8 or to set-up the program number on the seven-segment display LED 9. The multiplexed use of inputs A, B and C of IC-34 is accomplished by the $\overline{\text{BUSAC}}$ and $\overline{\text{BUSRQ}}$ Z80-CPU lines which control direct memory access to the microprocessor CPU address bus located on Figure 6-1.

The connection C1-36 controls the buzzer which is located on CCU-3 and is driven by transistor TR20.

1-6-4 Rotary Valve Printed Circuit Board (CCU-4).

Figure 6-3 shows the wiring of the rotary valve printed circuit board. This printed circuit board detects positioning of the rotary valve with six LED photocouplers which sense the slots appearing on the concentric ring, rotary valve position indicating mechanism. The station codes are sensed by PC10, PC11, PC12, and PC13. The open or closed positions at these individual stations are sensed by PC8 and PC9.

1-6-5 Battery Printed Circuit Board (CCU-2) and Retort Interlock (CCU-5).

Figure 6-4 shows the circuit diagrams for CCU-2 and CCU-5. The upper portion of the diagram shows the retort interlock circuit which uses photocoupler PC-14 to generate a signal indicating proper closure of the retort interlock slide. If the retort interlock slide is closed then a signal will be generated by PC-14 to turn on the green LED D14 on Figure 6-1.

The battery printed circuit board CCU-2 is connected to the main microprocessor control board via connection CN-14. A double pole, double throw switch is used to disconnect the lithium battery Li for ease of replacement. During battery replacement, the connection points C14-1 and 2 are protected from causing grounding of the basic $5 volt supply by the back biased diode D2 which is located on Figure 6-1. Diode D2 also isolates the battery Li during normal, fully powered operation of the instrument.

1-6-6 Connector Diagram and Heater Schematic.

Figure 6-5 shows the block diagram for the major connector functions. This is a more detailed diagram than that shown in Figure 1-6. The diagram shows the actual interconnection lines with the proper connector labeling. The connectors are labeled C1 through C14. The input ac line is connected directly to the main heaters for the retort, rotary valve, oven, and overflow tube heater. Connector C10 contains both triac turn on signals and OTP over temperature signals for the three heaters. Connectors C11, C12, and C13 connect the temperature sensor input signals from the oven, retort, and rotary valve respectively. The overflow sensor, which is located in close proximity to the overflow jar, is connected to the computer control unit (CCU-1) via C9. The rotary valve motor is connected to CCU-1 via C6. Connector C7 connects all signals for the operation of the pump, the solenoid valves, and the pressure switches.

The rotary valve printed circuit board (CCU-4), which is utilized for position sensing, is connected at C2. Connector C1, a sixty pin connector, is used to interconnect all signals to the front panel printed circuit board (CCU-3). The retort interlock printed circuit board (CCU-5) is connected via connector C4. The battery printed circuit board (CCU-2) is connected via connector C14. The external alarm relay is connected to CCU-1 through connector C5.

The 100 volt ac supply lines are connected to CCU-1 through connector C8. The dc power supply connections are directly wired from CCU-1 to the screw connection points on the switching type dc power supply. The isolation transformer T1 is nominally used as a step down transformer to obtain the 100 volt ac supply which is connected to the pressure switches, the pump, all of the solenoid valves, the rotary valve motor, and the overflow sensor. The output of transformer T1 is connected through a noise filter NF1 to the switching type dc power supply; this power supply is selected for use at 100 volts. The transformer secondary circuits are protected by a cartridge type fuse FU1.

The input ac power line ground wire is connected to the chassis through an inductance L. The ac power line hot and neutral wires are connected to the input of noise filter NF2; the output is connected to the circuit breaker NFB.

NOTE: The 100 volt ac power source derived from transformer T1 is floating with respect to the nominal line voltage connections appearing on CCU-1.

1-6-7 Terminal Wiring Diagram.

The screw type, terminal strip wiring diagrams are shown on Figure 6-6. At most locations throughout the instrument the wires that are connected to these terminal strips are labeled in one to one correspondence with the numbers indicated on the terminal strips.

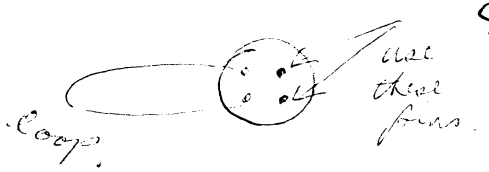
The diagram is self explanatory although it would be proper to note that the four retort heaters are connected in parallel and this parallel combination is connected in series with the 80°C and 97°C overtemperature protectors. The oven heaters are also connected in parallel and protected by series over temperature protectors.

The single cartridge rotary valve heater is similarly protected. The stainless steel tube connecting the retort

and the overflow jar is heated by a self-regulating heater H-4 and, as such, is not protected by over temperature protective devices.

The terminal strip located near the solenoid valve system on the air module uses a locally connected transient supressor SK4 to minimize transient signals from appearing in the wire bundle leading to the printed circuit board controller. In addition, 5.6K ohm resistors are connected across SV1, SV2 and SV3 to improve the current switching characteristics for the solid state relays SR2, SR3 and SR4. These resistors are mounted on the terminal strip.

The external alarm relay MR provides a closed circuit at terminals 1 and 2 of the rear panel receptacle during normal operation. (In newer models, relay MR is normally open and closes to energize alarm.) Terminals 3 and 4 are connected together to provide a connection test circuit to the remote location of the external alarm. Resistor R121 increases the switching current for the solid state relay; the series R-C combination SK-5 provides suppression of inductive transients.



SCR OPEN - NORMAL OPERATIO
CLOSED - ALARM CONDITIO

SECTION 2 GENERAL MAINTENANCE

2-1 CLEANING AND INSPECTION RECOMMENDATIONS

2-1-1 Aspirator and Overflow Trap.

2-1-1-1 Cleaning of Aspirator. Tools required: (+) screwdriver, double open-end spanner 14x17 and 13x17.

1. Remove the rear panel behind paraffin oven. See figure 2-1.
2. Disconnect Teflon tube by loosening plastic unions connecting aspirator. See figure 2-2.
3. Remove plastic unions at both sides of aspirator.
4. Remove aspirator from L tube.
5. Release cup and nozzle at air inlet side of aspirator. Clean off paraffin by rinsing nozzle, cup and aspirator with xylene.
6. Reassemble aspirator after confirming that no paraffin remains inside aspirator and nozzle.
7. Fasten rear panel of paraffin oven. See figure 2-1.

NOTE: When reassembling, apply new sealing tape around threads. Tape should start 1 thread in from threaded end.

Take care to prevent dust or foreign materials from entering tubing.

2-1-1-2 Cleaning of Overflow Trap. Tools required: (+) screwdriver, piano wire.

1. Remove outer panels for access to the overflow bottle. See figure 2-1.
2. Unscrew bottle from cap to remove it. See figure 2-3.
3. Clean paraffin from bottle with boiling water. Clean solutions from the bottle with water. Be sure to thoroughly remove moisture after cleaning.
4. If paraffin remains in overflow tube from retort to trap bottle, clean tube with piano wire, then flush with xylene poured from the retort end. Paraffin in the tube can also be removed by using trap bottle filled with boiling water.

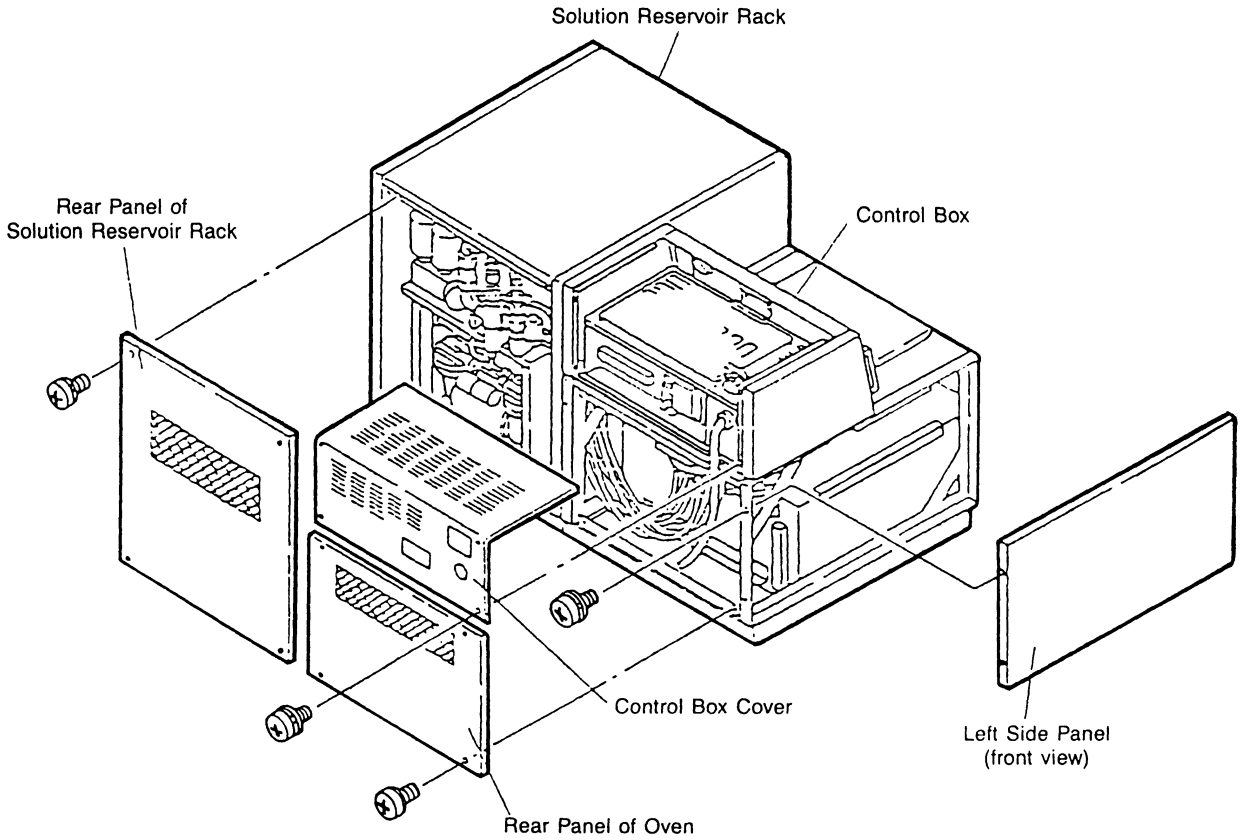


Figure 2-1. Panel Removal

5. Screw bottle into cap securely to achieve proper seal.

CAUTION

If a tight seal is not achieved, serious instrument malfunctions may occur.

6. Fasten outer panels in place. See figure 2-1.

NOTE: If wet bottle is installed, the overflow sensor may be activated. Take care to thoroughly remove moisture from trap bottle before screwing it into cap.

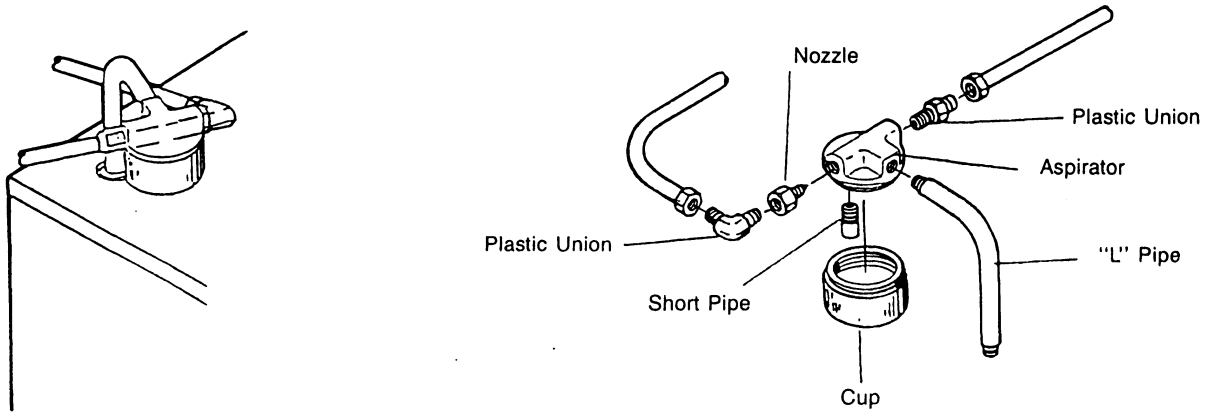


Figure 2-2. Aspirator Assembly

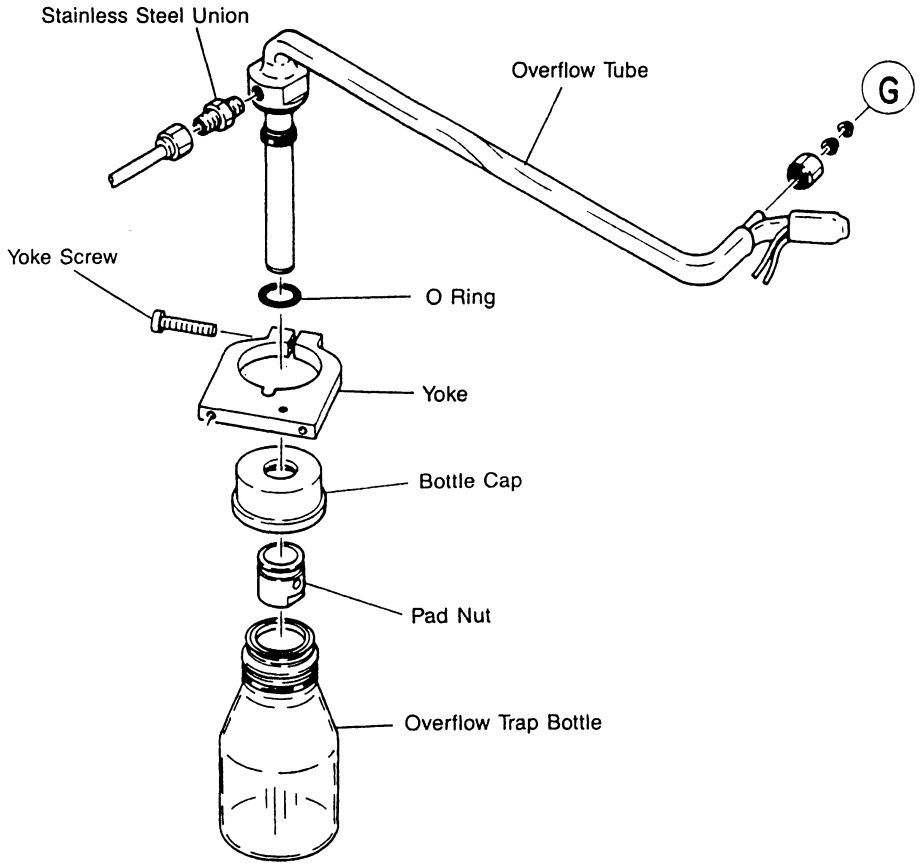


Figure 2-3. Overflow Trap

2-1-2 Retort.

CAUTION

Oven and paraffin containers are hot! Exercise care when cleaning.

AFTER THE PROCESSING PORTION OF EACH CYCLE, clean the retort. Use the plastic scraper to remove all paraffin from the sides and lid of the retort, before initiating the cleaning cycle.

2-1-3 Reservoirs.

PERIODICALLY carefully inspect all reservoir caps and cap gaskets. Inspect caps for cracks and worn threads. Inspect cap gaskets for cracks and deterioration.

DAILY, when instrument is not in use, dispose of the water in the water reservoir, then fill to proper level with tap water.

2-1-4 Exterior Surfaces.

DAILY clean the control panel, plastic and painted areas by wiping with a clean cloth moistened with mineral oil. DAILY clean the inside of the reservoir storage compartment by wiping with a clean cloth.

2-1-5 Spill Trays.

DAILY remove both spill trays; clean them thoroughly by wiping with a clean cloth. Remove any paraffin accumulations with a scraper, before wiping with a clean cloth.

2-1-6 Inlet/Outlet Filter.

DAILY remove the inlet/outlet filter in the bottom of the retort. This is done in newer units by unscrewing the center post and in older units by grasping the center post and pulling straight up. Clean thoroughly with a cloth moistened with xylene before reinstalling.

2-1-7 Condensate in Air Manifold.

Condensation from processing fluid vapors can be trapped in the left side of the lower air manifold. The manifold should be drained at one year intervals. For this purpose a removable seal, held by a screw, is provided. For access to the screw, remove the rear panel behind the pump; then

1. Place a small beaker (about 100 ml) under the screw, figure 2-4.
2. Remove screw and seal, and allow liquid condensate to drain into beaker.
3. Reattach seal with screw. Tighten firmly. Remove beaker and reattach rear panel.

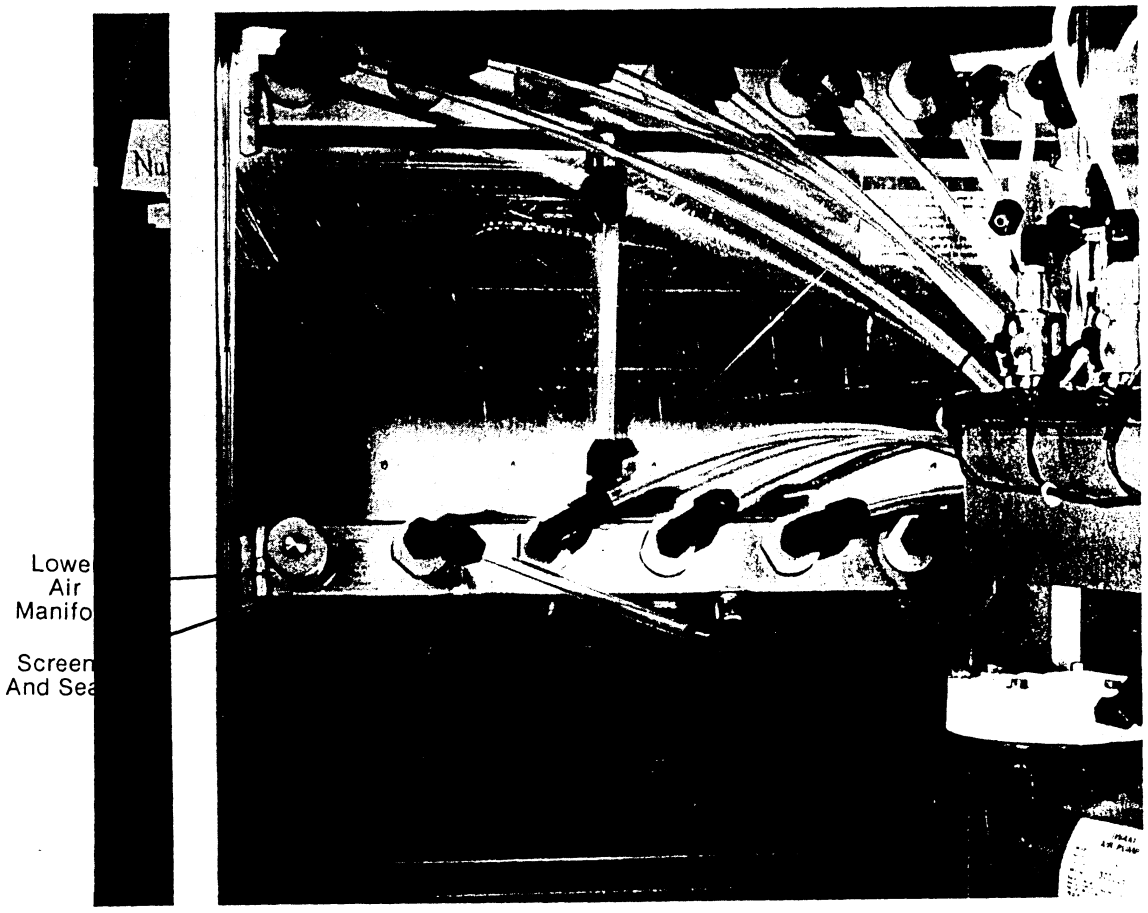


Figure 2-4. Manifold Drain Location

2-2 MECHANICAL ADJUSTMENTS

The pressure-sensing switches, relief valves, and retort cover may require mechanical adjustment.

2-2-1 Air/Vacuum System.

2-2-1-1 How to Release Air Unit. Tools required: (+) screwdriver, double open-end spanner (14x17), hexagon wrench 5 mm, tube cutter.

1. Remove the rear panel of reservoir rack. See figure 2-1.
2. Disconnect lead wires of control box from terminal block.
3. Remove unions (arrows) which connect the air unit with another component. See figure 2-5.
4. Remove hexagon socket head bolts which fasten the air unit on the base.
5. Remove the air unit.

2-2-1-2 Replacement and Adjustment of Pressure Switch (PS1) at Pressure Side. To replace Pressure Switch (PS1):

Tools required: (+) screwdriver, (−) screwdriver, double open-end spanner 14x17, box driver 7 mm, adjustable wrench 250 mm.

1. First, disconnect electric power.

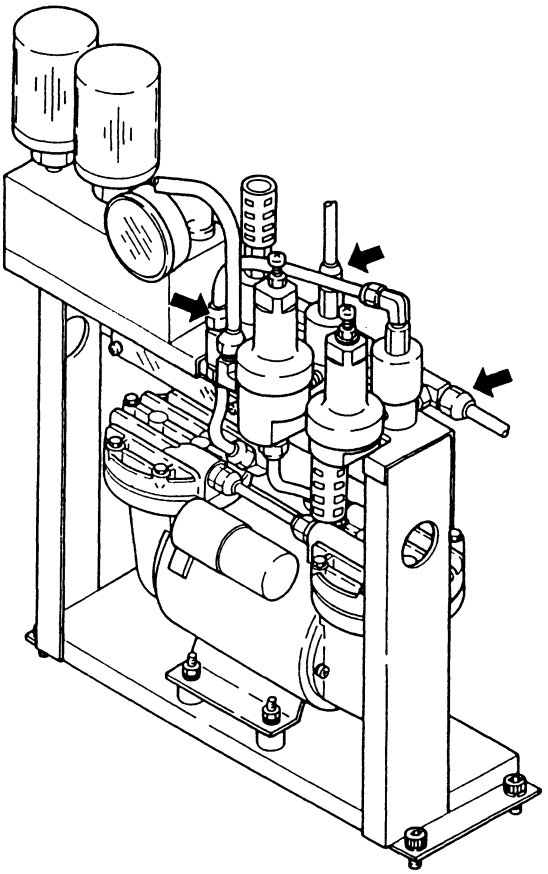


Figure 2-5. Air/Vacuum System

2. Remove pressure switch from manifold with wrench. See figure 2-6.
3. Clean old sealing tape remaining inside nipple and manifold, then apply new sealing tape on nipple. Take care to prevent scraps of sealing tape fr entering into manifold (shake out dust fr manifold).
4. Attach new pressure switch to manifold.
5. Reattach pressure switch manifold. See figure 2-5.

To adjust Pressure Switch (PS1):

Tools required: (−) screwdriver.

1. Make sure power is turned off source before removing cover.

CAUTION:
Do not adjust screws A or B with instrument power on. High voltage (110 Vac) is present at these screws.

2. Adjust pressure switch (figure 2-7) as follows:

Maximum operating pressure = 0.2 ± 0.05 kg/cm² (closing pressure)
Minimum operating pressure = 0.15 ± 0.05 kg/cm² (opening pressure)
Differential pressure = 0.05 ± 0.05 kg/cm²

3. Turning adjusting screw (A) will affect both maximum and minimum operating pressures without affecting differential, as shown in figure 2-8. Turning the screw clockwise will decrease operating pressures. (Pointer will move toward L on scale.) Turning the screw counterclockwise will increa operating pressures. (Pointer will move toward H on scale.) When turning screw, take care that pointer does not go off scale.

4. Turning adjusting screw (B) will change maximum operating pressure without affecting minimum operating pressure as shown in figure 2-9. Turning the screw clockwise will decrease maximum operating pressure and turning it counterclockwise will increase it.

   When adjusting screw (B), contact spacing at screw (B) should be 0.5 to 1.2 mm.

Adjustment Procedure:

1. With instrument power off, remove switch cover and adjust screws A and/or B approximately to required position.
2. Turn on instrument power and place select magnet on MANUAL position.
3. Select station 16.
4. Open retort. Leave lid open and slide interlock to closed position.
5. Perform manual operations 06, 08 and 09, Table 3-2.
6. Use your finger to block the air entry port to the retort. Observe the vacuum/pressure gauge and listen to switch action to determine whether pre sure switch has been adjusted correctly.

NOTE: Release finger pressure slightly to determine minimum operating pressure. Press OFF to cancel manual operations selected in 5.

7. Repeat steps 1 through 6, above, as required until adjustment of switch is correct.
8. Apply Loctite to threads of screws A and B to prevent movement.

2-2-1-3 Replacement and Adjustment of Vacuum Switch (PS2). To replace Vacuum Switch (PS2):

Tools required:(+) screwdriver, double open-end spanner 14x17 box driver 7 mm, adjustable wrench 250 mm.

1. First, disconnect electric power.
2. Remove switch from manifold with wrench. See figure 2-6.
3. Clean old sealing tape remaining inside nipple and manifold, then apply new sealing tape on the nipple. Take care to prevent scraps of sealing tape from entering into manifold (shake out dust from manifold.)
4. Attach new switch to manifold.
5. Reattach switch manifold. See figure 2-5.

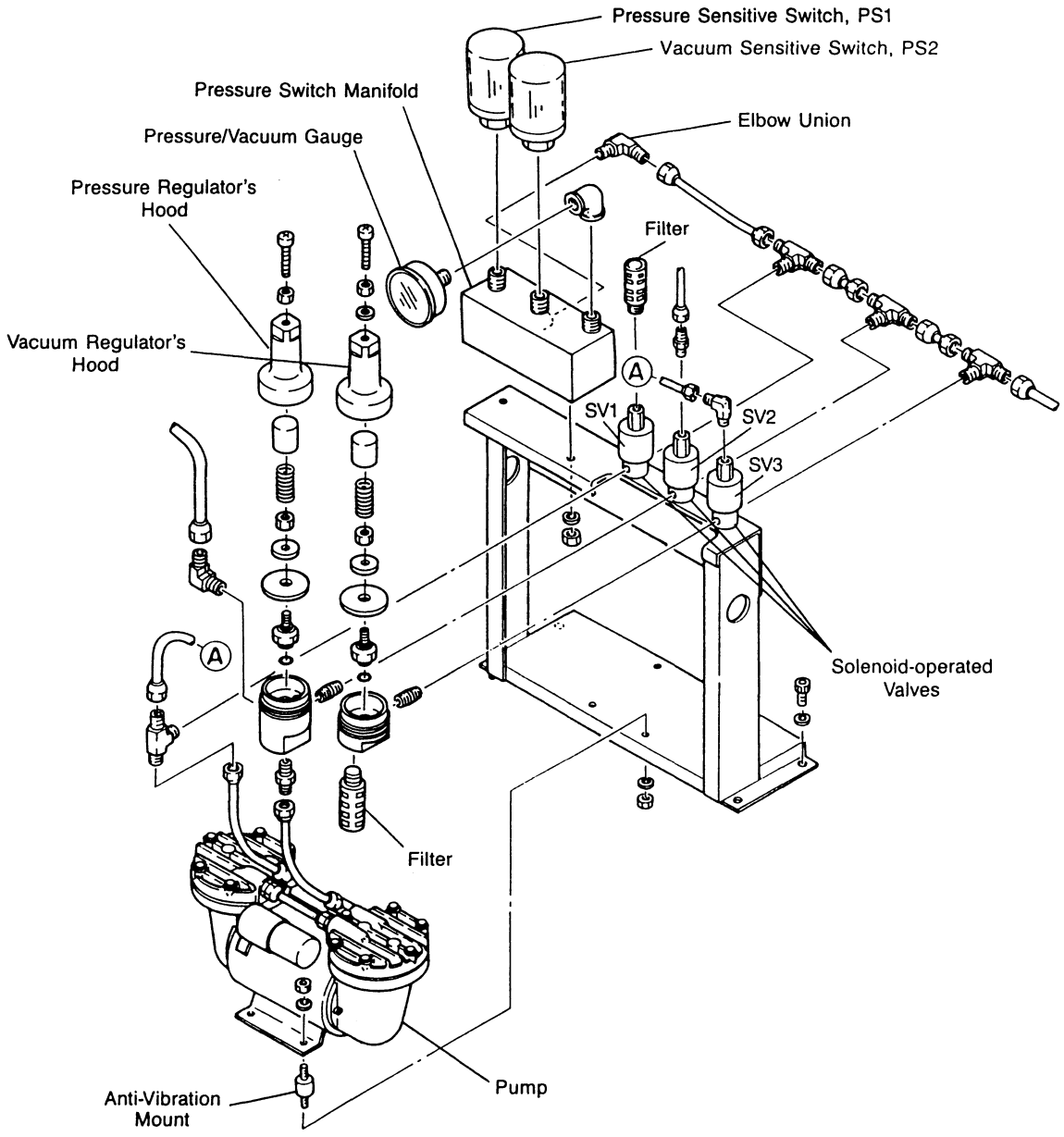


Figure 2-6. Air/Vacuum System, Exploded View

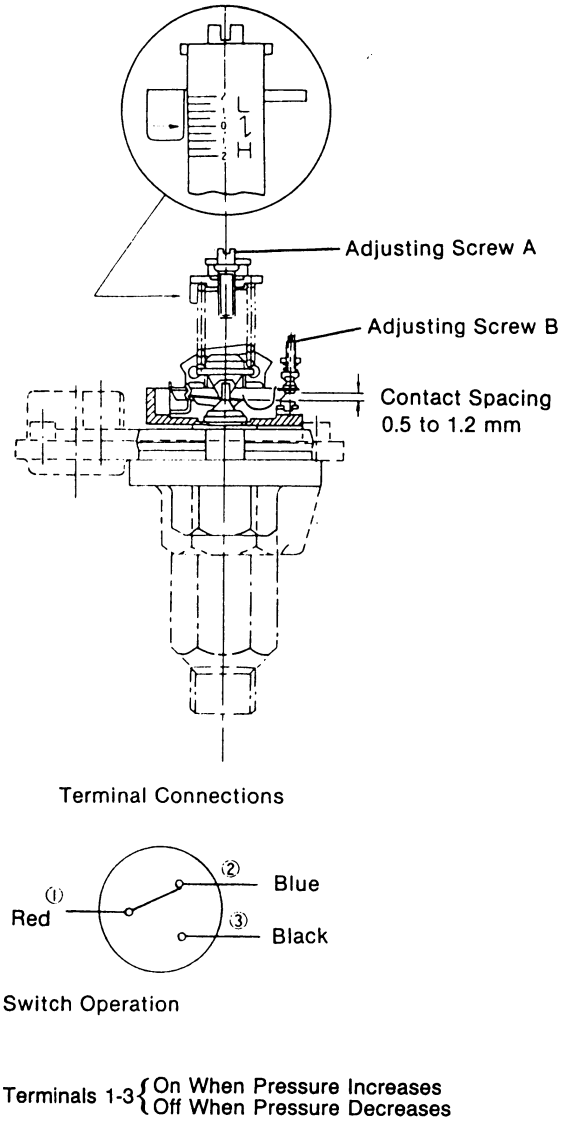


Figure 2-7. Pressure Switch PS-1 Adjustments

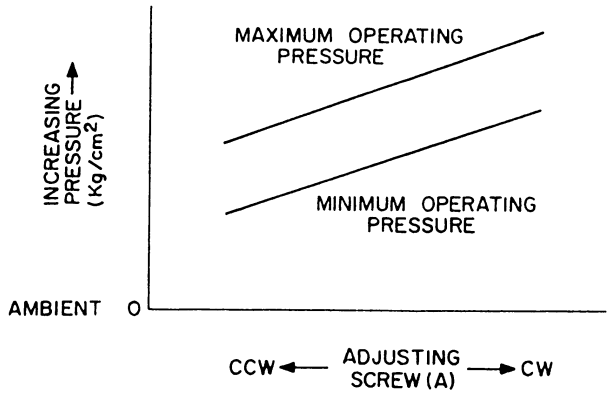


Figure 2-8. Effect of Adjusting Screw A

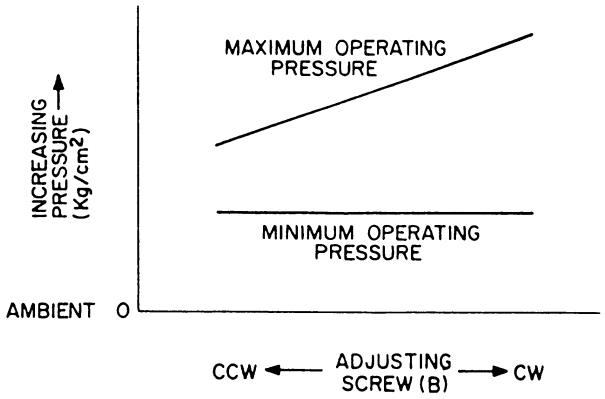


Figure 2-9. Effect of Adjusting Screw B

To adjust Vacuum Switch (PS2):

Tools required: (−) screwdriver.

1. Make sure to turn off power source before removing switch cover.

CAUTION

Do not adjust screws A or B with instrument power on. High voltage (100 Vac) is present at these screws.

2. Adjust vacuum switch (figure 2-10) as follows:

Maximum operating vacuum = 14 ± 1 cm Hg (opening vacuum)
Minimum operating vacuum = 12 ± 1 cm Hg (closing vacuum)
Differential vacuum = 2 ± 0.5 cm Hg

3. Turning adjusting screw (A) will affect both maximum and minimum operating vacuums without affecting the differential as shown in figure 2-11. Turning the screw clockwise will increase operating vacuum. (Pointer will move toward H on scale.) Turning screw counterclockwise will decrease operating vacuum. (Pointer will move toward L on scale.) When turning screw, take care that pointer does not go off scale.
4. Turning adjusting screw (B) will change minimum operating vacuum without affecting maximum operating vacuum. Turning screw (B) clockwise will cause minimum operating vacuum to approach high vacuum and turning it counterclockwise will cause minimum vacuum to be lowered toward ambient pressure, as shown in figure 2-12.

When both screws (A) and (B) have been adjusted, contact spacing at screw (B) should be within 0.5 to 1.2 mm.

Adjustment Procedure:

1. With instrument power off, remove switch cover and adjust screws A and/or B approximately to required position.
2. Turn on instrument power and place select magnet on MANUAL position.

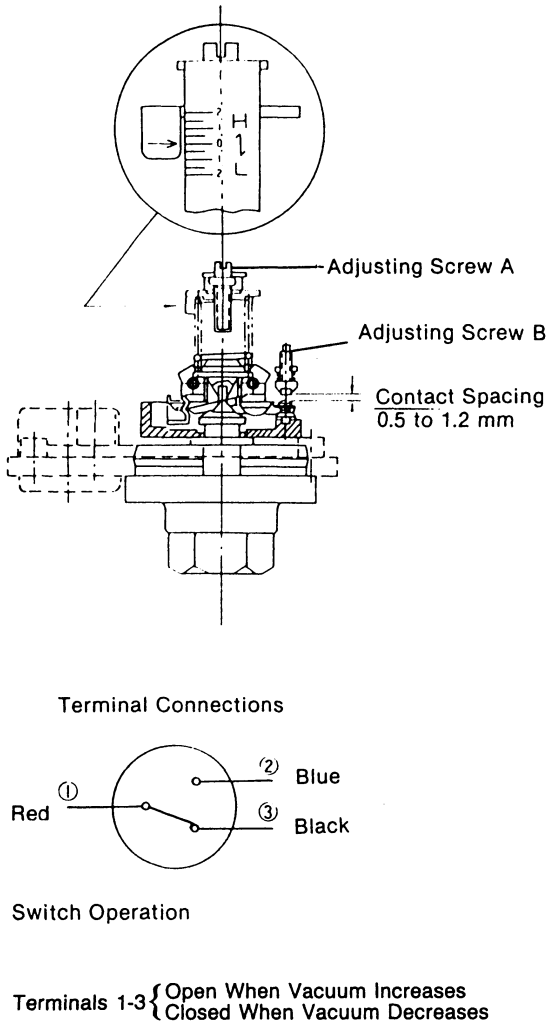


Figure 2-10. Vacuum Switch PS2 Adjustments

3. Select station 16.
4. Open retort. Leave lid open and slide interlock to closed position.
5. Perform manual operations 06 and 07, table 3-2.
6. Use your finger to block the air entry port to the retort. Observe the vacuum/pressure gauge and listen to switch action to determine whether vacuum switch has been adjusted correctly.

NOTE: Release finger pressure slightly to determine minimum operating pressure. Press OFF to cancel manual operations selected in 5.

7. Repeat steps 1 through 6, above, as required until adjustment of switch is correct.
8. Apply Loctite to threads of screws A and B to prevent movement.

2-2-1-4 Diaphragm and O-Ring Replacement Vacuum Regulator Adjustment. Tools required: Adjustable wrench 250 mm, (+) screwdriver, double open-end spanner 14x17 and 7x8, stubby (+) screwdriver, Locktite (red).

To replace diaphragm and O-ring in vacuum regulator:

1. Release hood with adjusting screw. See figure 2-13.
2. Remove spring guide and spring.
3. Release V valve with diaphragm. Remove nut to replace diaphragm.
4. Reassemble V valve.
5. Remove O ring inside V regulator body. Clean inside of body.
6. Fit new O ring into V regulator body.
7. Clean surface of V valve contacting O ring. Attach V valve to V regulator body.
8. Lay spring, spring guide, and hood in place on V regulator body and fasten them.
9. Fasten hood finger tight and then use a 10 mm spanner to tighten it.

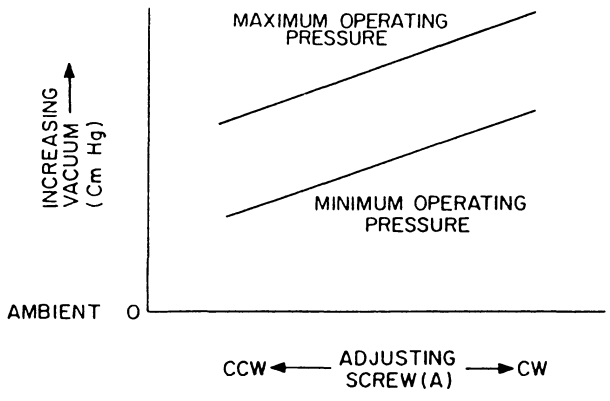


Figure 2-11. Effect of Adjusting Screw A

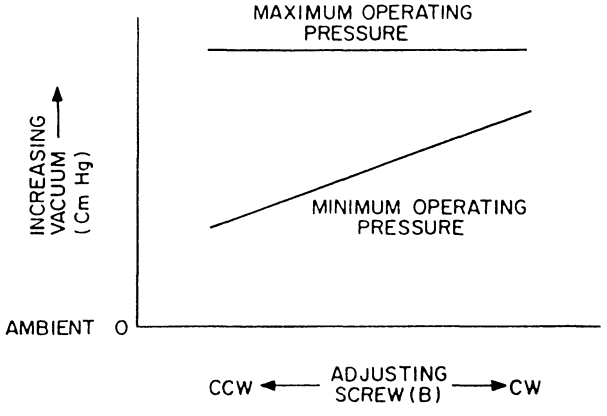


Figure 2-12. Effect of Adjusting Screw B

To adjust Vacuum Regulator:

1. Turn on power switch and perform pump-in with manual mode using the station which is filled with solution. Turn adjusting screw until pressure gauge shows 20 cmHg. Turning it clockwise will increase vacuum and turning it counterclockwise will decrease vacuum.
2. Repeat the above step several times to confirm the set value and then fasten nut of adjusting screw.
3. Apply Locktite to adjusting screw and threaded part of hood and V regulator body.

2-2-1-5 Diaphragm and O-Ring Replacement, Pressure Regulator Adjustment. Tools required: Adjustable wrench 250 mm, (+) screwdriver, double open-end spanner 14x17 and 7x8, stubby (+) screwdriver, Locktite (red).

To replace diaphragm and O-ring in pressure regulat

1. Release hood with adjusting screw. See figure 2-13.
2. Remove spring guide and spring.
3. Release P valve with diaphragm. Remove nut to replace diaphragm.
4. Reassemble P valve.

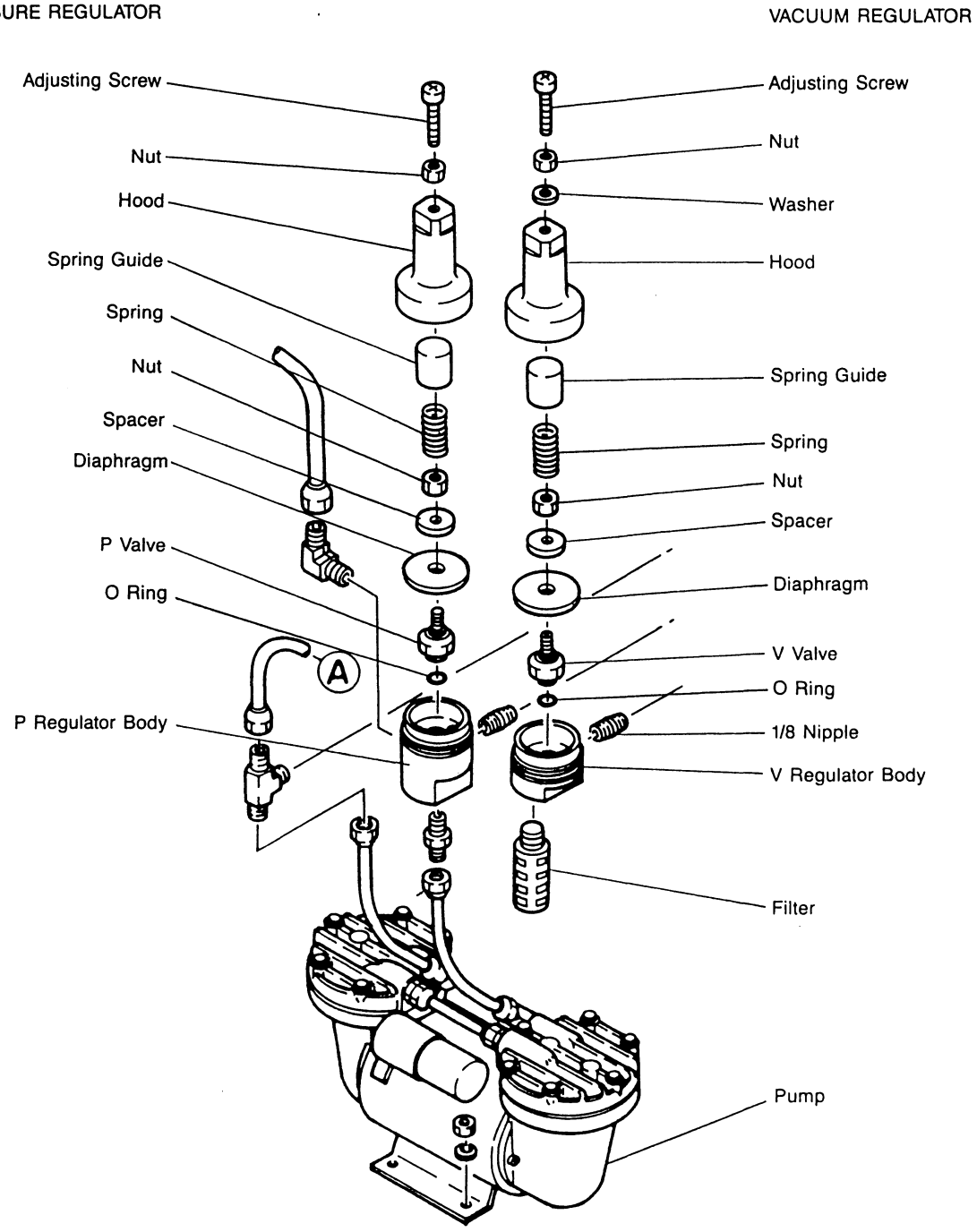


Figure 2-13. Pressure and Vacuum Regulators

5. Remove O ring inside P regulator body. Clean inside of body.
6. Fit new O ring into P regulator body.
7. Clean surface of P valve contact O ring. Attach P valve to P regulator body.
8. Lay spring, spring guide, and hood in place on P regulator body and fasten them.
9. Fasten hood finger tight and then use a 10 mm spanner to tighten it.

To adjust Pressure Regulator:

1. Turn on power switch and perform pump-in and pump-out with manual mode using the station which is filled with solution. Turn adjusting screw until pressure gauge shows 0.35 kg/cm^2. Turning it clockwise will increase pressure and turning it counterclockwise will decrease pressure.
2. Repeat the above step several times to confirm set value and then fasten nut of adjusting screw.
3. Perform P/V cycle in automatic operation to confirm that pressure remains above 0.3 kg/cm^2.
4. Apply Locktite to adjusting screw and threaded part of hood and V regulator body.

2-2-2 Relief Valves.

In older models there is a relief valve in pneumatic series with solenoid-operated valve SV3 which limits vacuum during pump-in to a nominal 20 cm Hg, and another relief valve in parallel pneumatically with SV2 to limit pressure during pump-out to 0.35 kg/cm^2. The vacuum relief valve should operate in the range of 18 to 25 cm Hg. The pressure relief valve should operate in the range of 0.25 to 0.3 kg/cm^2. If either valve goes out of specification, replace it with an identical valve or with the newer type regulator.

To remove a vacuum relief valve:

Refer to figure 2-6.

1. Unscrew capnuts and pull Teflon tubes from tee.
2. Remove conversion joint B together with tee.
3. Remove relief valve.
4. Remove remnants of sealing tape from all threads opened in steps 1 through 3, above.

To install a vacuum relief valve:

1. Apply two layers of sealing tape to male threads of all parts to be joined. The tape shall start 1½ screw threads from the threaded end.
2. Install valve by reversing steps 1 through 3 under valve removal, above.

Install the valve and confirm the relief pressure by performing manual pump-in and pump-out. Use the methods described under PS1 and PS2 adjustments (Paragraph 2-2-1).

To remove a pressure relief valve:

Refer to figure 2-6.

1. Unscrew capnuts and pull Teflon tubes from tee.
2. Remove conversion joint A together with tee.
3. Remove relief valve.
4. Remove remnants of sealing tape from all threads opened in steps 1 through 3, above.

To install a pressure relief valve:

1. Apply two layers of sealing tape to male threads of all parts to be joined. The tape shall start 1½ screw threads from the threaded end.
2. Install valve by reversing steps 1 through 3 under valve removal, above.

Testing procedures are the same as for vacuum relief valve.

2-2-3 Retort Cover Adjustment.

The retort cover must be held tightly when closed in order to provide adequate sealing. Sealing is accomplished by fastening two latches, figure 2-14.

To tighten a latch, turn the latch hook clockwise in its threaded yoke, taking care not to over-tighten; to loosen, turn counterclockwise. If the retort does not seal properly when latches have been tightened, the retort cover gasket may be the source of trouble. Replace the gasket. See paragraph 4-7-7.

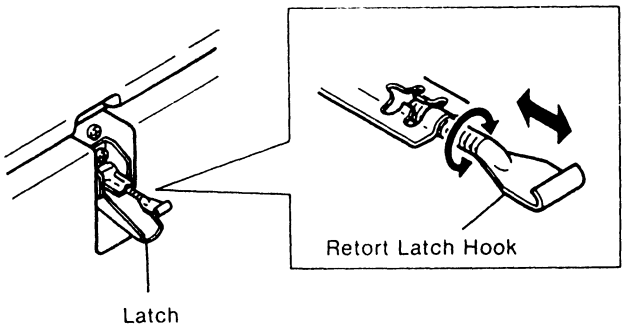


Figure 2-14. Retort Cover Latch

2-3 ELECTRICAL ADJUSTMENTS

The power supply, the control board, and the overflow sensor may require occasional adjustment.

2-3-1 DC Power Supply.

Tools required: (+) screwdriver, (−) screwdriver, voltage meter. Remove control box cover. See figure 4-1.

The output of the power supply should be adjusted to 5.05 Vdc. Attach leads of VTVM or DVM to +5 test point and GND test point on control PC board. See figure 2-15. Turn adjusting screw on power supply to obtain a reading of 5.05 ± 0.05 Vdc on meter. Check for 5.05 Vdc at Vcc test point on control board (near CN1) and GND test point (near CN3). Also check for approximately 5.00 Vdc at RAM Vcc test point (near SW2). Detach voltage meter and attach control box cover. See figure 4-1.

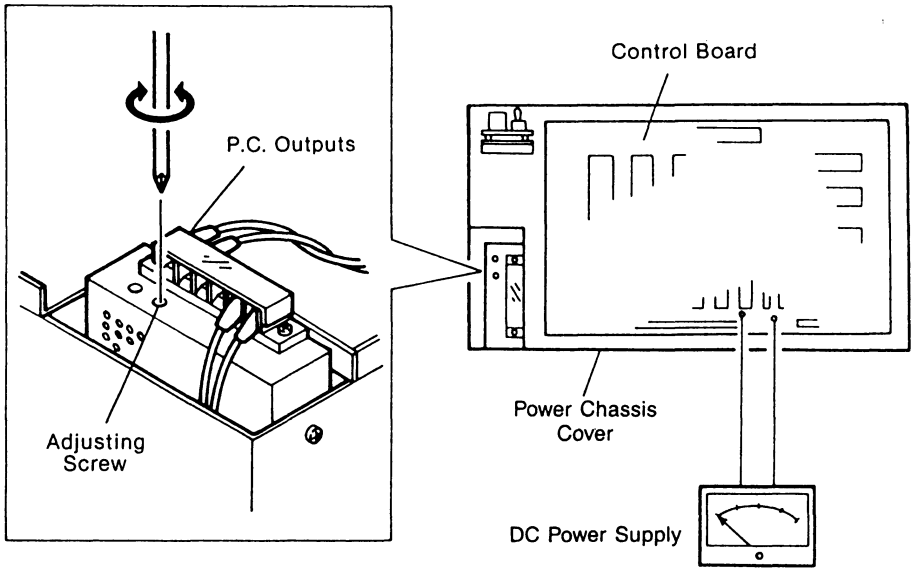


Figure 2-15. DC Power Supply Adjustment

2-3-2 Power Failure Detector.

The power failure detector can be adjusted using the internal dc power supply and a 3 digit digital volt meter.

2-3-2-1 Detector Threshold Adjustment. Prior to following this procedure, make sure the battery is on. Otherwise all RAM can be lost, requiring reprogramming of all program data.

The following procedure should be used to set the threshold voltage:

1. Connect the DVM negative lead to the ground test point on the CCU-1 board. Connect the positive lead to the VCC (not RAM VCC) test point.
2. Adjust the power supply voltage down toward 4.8 volts by rotating the supply adjustment pot slowly (the pot is very sensitive) counterclockwise (CCW), while watching the front panel display digits. When the display digits go blank, stop and record the measured voltage.
3. Adjust the power supply voltage up toward 4.9 volts by rotating the supply adjustment pot very slowly clockwise (CW), while watching the front panel display digits. When the display digits come on, stop and record the measured voltage.
4. The recorded voltages should be:
   ON at 4.90 ±.05 VDC
   OFF at 4.80 ±.05 VDC
   DIFFERENCE =.08 to .13 VDC (ON voltage—OFF voltage=DIFFERENCE)

NOTE: If the difference is out of specification, the circuit is defective. There is no adjustment for this range.

5. If the power failure detector is in specification, go to step 11.
6. If the power failure detector is out of specification, adjust the supply to 4.90 ±.01 VDC.
7. If the display digits are now blank, go to step 9.
8. If the display digits are now illuminated, adjust pot VR1 (on the CCU-1 board) CCW until the display digits go blank. Continue to step 9.
9. Adjust pot VR1 (on the CCU-1 board) CW until tl digits come on.
10. Repeat steps 2 through 5, until the specification is satisfied.
11. Complete this procedure by adjusting the power supply voltage back to 5.05 ±.05 VDC.

2-3-3 Overflow Sensor Adjustment.

Tools required: (+) screwdriver, (−) screwdriver for sensor adjustment.

1. Confirm that bottle-to-sensor gap is 5mm (1/4 inch).
2. Remove outer panels for access to overflow trap bottle. See figure 2-1.
3. Pour 170 ml of pure xylene into trap bottle and reseat the bottle securely.
4. Adjust sensor-to-bottle distance to 5 mm. See figure 2-16.
5. Remove small Phillips head screw from rear of sensor housing. See figure 2-16.
6. Rotate small slotted adjusting screw slowly until red LED illuminates.
7. Back off screw one turn and repeat the above step slowly until LED just illuminates.
8. Reinstall Phillips head screw.
9. Reseat overflow trap bottle after cleaning.
10. Fasten outer panels in place.

2-4 BATTERY REPLACEMENT

Dots of the LED status display will illuminate and flash when the battery is nearly exhausted. The memory can be stored for several hours of power failure even if the dots are flashing, since the battery is not completely exhausted. However, it is recommended the battery be replaced as soon as possible as indicated in paragraph 4-13-1.

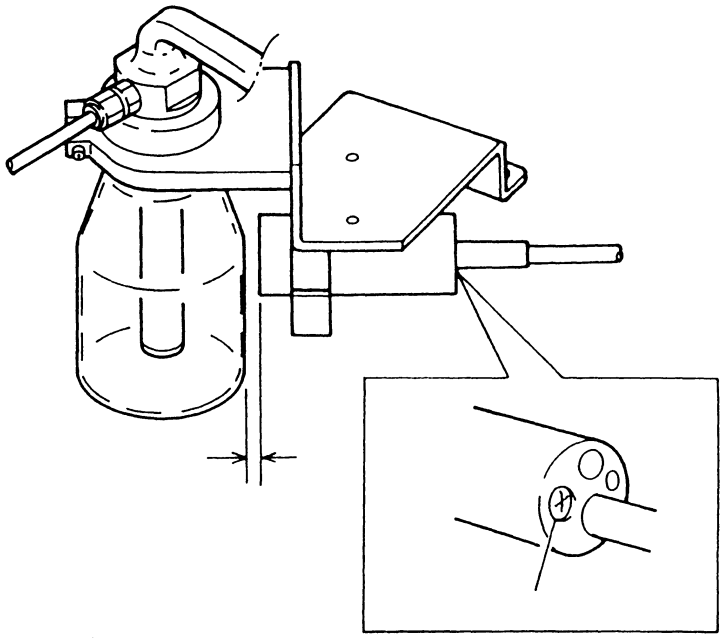


Figure 2-16. Overflow Sensor Adjustment

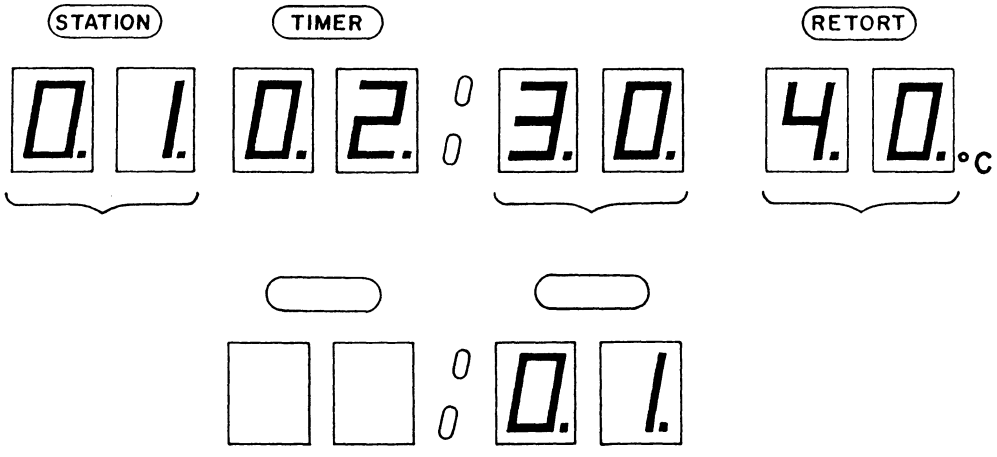


Figure 2-17. Status Display

Section 3 SYSTEM ALARMS AND TROUBLESHOOTING

3-1 CONTENTS OF SECTION

This section provides aids to the identification of processor malfunctions and their probable causes.

Several safety devices and alarm devices are provided with this instrument. If alarm is indicated, the meaning will be displayed. Two categories are included in the alarm system; the alarm for operator's responsibility and the alarm for serviceman's responsibility.

3-2 FRONT PANEL ALARMS

The following front panel alarm displays are self-explanatory, and should not require a service call:

RETORT UNLOCK

FLUID LOW

POWER OUT

STANDBY

3-2-1 Retort Unlock.

RETORT UNLOCK will flash if the retort interlock slide is not locked. Retort interlock also has the following functions.

1. Stop Buzzer

   Releasing the retort interlock will stop the buzzer. However, releasing the interlock while the buzzer is not sounding will make the buzzer sound. (During clock operation, programming, or manual key-in, the buzzer will not sound if the interlock is released.)

2. Interrupt Operation

   Releasing the retort interlock during automatic operation or cleaning cycle will immediately stop the operation and the processing timer.

   Operation will be resumed after the interlock is again locked. The end time of the process, however, is delayed for the length of time that processing is interrupted.

   Releasing the interlock during manual operation will also immediately stop the operation. Operation will be resumed after the interlock is locked.

3. Stop Other Alarm Indication

   Alarm indications, except for STANDBY, will stop flashing, if the retort interlock is released and relocked. Although DIAGNOSE will stop flashing when the interlock is operated, the error number registered in DIAGNOSE will remain on display.

3-2-2 Fluid Low.

FLUID LOW will flash if no solution or paraffin is in reservoir or paraffin container or if reservoir or paraffin container is not set. At that time error code E-14 is stored but DIAGNOSE does not flash. When FLUID LOW flashes, even though the filled reservoir or paraffin container is set, there is a malfunction. See E-14 in paragraph 2-2-3. Depending on the situation, various action may be taken when FLUID LOW is detected.

1. During Automatic Operation

   If FLUID LOW is detected at Station 1, the alarm will be given immediately after detection. Automatic operation can be resumed after filling the reservoir by following the starting procedure: the select magnet is placed on PROGRAM and removed, then the control switch is pushed.

   If FLUID LOW is detected at Station 2 through 10, pump-out will be performed at the station after the detection. Then, returning to the previous station to perform pump-in, so that solution fills the retort, the system will give the alarm. If another FLUID LOW Is detected at the reached station, the same operation will be repeated until the station with the filled reservoir is reached. Having returned to Station 1, the operation will stop. After the reservoir with solution is set, releasing and relocking the retort interlock slide will light START control. Then, the control switch is pushed so that the solution remaining in the retort is pumped out, and the operation is resumed from the next station.

NOTE: If FLUID LOW is detected during automatic operation, the reservoir with solution is set at the station next to the stopped station, since the operation stops at the station previous to the station where FLUID LOW was detected.

   If FLUID LOW is detected at Station 11 through 13, when FLUID LOW is detected at the first pump-in after moving from Station 10, the alarm will be given after returning to the previous station to perform pump-in, so that the retort is filled. The same operations will follow as stated in the case of Station 2 through 10. When FLUID LOW is detected at or after the second pump-in, the alarm will be given immediately. After the container with paraffin is set, releasing and relocking the retort interlock slide will light the START control. Then, the control switch is pushed so that the pump-in is resumed and the automatic operation is also resumed.

2. During Cleaning Cycle

   If FLUID LOW is detected during cleaning cycle, the alarm will be given immediately. After the reservoir with solution is set, releasing and relocking the retort interlock slide will light the CLEAN control. Then, the control switch is pushed to start pump-in and the cleaning cycle is resumed.

3. During Manual Operation

   If FLUID LOW is detected during manual pump-in (manual number 02), the alarm will be given immediately. After the reservoir with solution is set, releasing and relocking the retort interlock slide will enable manual operation to continue.

3-2-3 Power Out.

In case of a power failure or accidental disconnection of the instrument from the power source, POWER OUT display will illuminate when power is restored. At the same time, error code E-03 is stored, but DIAGNOSE does not flash. When POWER OUT is flashing the alarm does not sound. STANDBY may be flashing also. See paragraph 1-4-3-1. The primary purpose of the display is to alert the operator to the fact that there has been a power interruption. Duration of the interruption can be determined by comparing the TIME display with a timepiece which has not been affected. The TIME display will require reprogramming to display correct time. See operator's manual.

3-2-4 Standby.

STANDBY will flash when paraffin is not melted or the temperature of the retort and the rotary valve does not reach the temperature required for operation. Details are discussed in paragraph 3-2-4 (2) below.

1. Requirements for paraffin melting.

   Paraffin is judged as being melted when the temperature of the paraffin oven has stayed higher than the paraffin melting point (higher than the average of the set temperature of Station 11 through 13) for enough time to melt paraffin thoroughly. Enough time means the following:

   - If power failure takes place at Station 1 through 10, 15 and 16 while paraffin is melted, when power is restored, the following oven temperatures will result in the corresponding processing delays:

Higher than (set temperature-12°C)	0 hour
Higher than (set temperature-14°C)	1 hour 30 minutes
Higher than (set temperature-16°C)	2 hours 20 minutes
Higher than (set temperature-18°C)	3 hours 30 minutes
Higher than (set temperature-20°C)	4 hours 30 minutes
Lower than the above temp. difference	24 hours

   - If power failure takes place at Station 11 through 13 while paraffin is melted, when power is restored, the following retort temperatures will result in the corresponding processing delays:

Higher than (set temperature-4°C)	1 hour
Higher than (set temperature-6°C)	1 hour 30 minutes
Higher than (set temperature-8°C)	2 hours 30 minutes
Higher than (set temperature-10°C)	3 hours 30 minutes
Higher than (set temperature-12°)	4 hours 30 minutes
Higher than (set temperature-14°C)	5 hours 30 minutes
Lower than the above temp. difference	24 hours

   - If power failure takes place when paraffin is not melted (STANDBY flashes), process will be delayed 24 hours after the restoration of power
   - If the oven temperature goes down lower than (set temperature-3°C) due to trouble other than power failure, processing will be delayed for 24 hours.
   - Right after the installation of the instrument, 24 hours are required to melt the paraffin.

2. The meaning of STANDY.

   a) During clock operation or programming.

   STANDBY indicates that paraffin is not metled.

   b. During Pump-In or Pump-Out.

   STANDBY flashes when the temperature of the rotary valve at Station 11 through 13 is lower than (preset temperature-1)°C, or the temperature of the retort is lower than (preset temperature-1)°C, or the paraffin is not melted. The operations of pump-in or pump-out will stop until the temperatures are corrected and the paraffin is melted.

   c. During manual operations except for pump-in or pump-out.

   STANDBY flashes when paraffin is not melted.

   When STANDBY flashes with the buzzer right after pressing ON/ENTER, the temperature of the rotary valve is lower than 69°C or the temperature of the retort is lower than the set tem perature.

   d. During automatic operation except for Pump-In or Pump-Out.

   The automatic operation will not start when paraffin is not melted. Paraffin is usually melted, but sometimes it will be solidified due to power failure.

   After automatic operation starts, even if paraffin solidifies due to power failure between Station 1 and 10, STANDBY will not flash immediately and the automatic operation will proceed to Station 10. After completing processing at Station 10, pump-out will not be performed until paraffin is melted, while STANDBY keeps flashing. (If Station 10 is set as 00:00, the operation will halt at Station 10 without pumping in the solution. So, Station 10 must be programmed.)

   If paraffin is solidified due to power failure between Station 11 through 13, the automatic operation will halt until paraffin is melted without starting right after the power is restored, while STANDBY keeps flashing. After paraffin is melted and STANDBY disappears, automatic operation will be resumed.

   If the temperature of the paraffin oven goes down due to failure of the temperature contr

circuit during automatic operation, DIAGNOSE and STANDBY will flash. When DIAGNOSE begins to flash, automatic operation will stop.

3-2-5 Diagnose.

Whenever the DIAGNOSE display illuminates, whether flashing or not, specimen processing is interrupted. It is then necessary to place the processor in the PROGRAM mode and press the AM-PM/DIAGNOSE key on the keyboard to bring an error code display to the front panel. The display will appear under TIME, as E-nn, to identify the fault. A DIAGNOSE display is accompanied by an audible buzzer.

3-2-6 Error Codes.

The error codes (E-nn) fall into several groups as detailed below:

01, 02, 10	Retort overflow
03	Power failure
11-14	Pump-In
20-23	Pump-Out
30-39	Temperature control
40-41	Rotary valve clockwise rotation
50-53	Rotary valve opening
60-67	Rotary valve closing
70-74	Rotary valve counterclockwise rotation.

If an error display appears, press the AM-PM/DIAGNOSE key again to determine if more than one error codes.

3-2-7 Other Malfunctions and Troubleshooting.

3-2-7-1 Microprocessor Malfunction.

Symptom

In some situations caused by external noise or defectiveness of IC chips, none of the control functions and system alarms can function. Every display is out of control and does not respond to switches on the control panel.

Remedy

To return the microprocessor to normal operation:

1. Unlock retort interlock slide.
2. Place select magnet on MANUAL.
3. Lock interlock slide.
4. Remove magnet.

This procedure will abort the infiltration run.

If procedure above does not restart operation, press reset switch on control P.C. board. When this is done, microprocessor must be reprogrammed.

If use of reset switch does not restart unit, replace control P.C. board. See paragraph 4-5-2.

Determine whether the instrument is near machines generating high frequency electronic noise or drawing large electrical currents. If so, connect the instrument to a separate electric line from these machines.

Provide the air pump and the solenoid-operated valve with a spark killer in parallel.

If the microprocessor hang-up recurs even after the above remedies are applied, contact the Ames Technical Service Department.

After a microprocessor hang-up is corrected, repair the damage caused by the hang-up (e.g., reset thermal fuses).

3-2-7-2 Output Voltage Decrease at 5 Volt DC Power Supply.

Symptom

7 segment LED's on the front panel will not illuminate and the keys cannot operate even though the power (90 - 100 percent of the rated voltage) is supplied. Green LED's (D4) on the control PC board are not illuminated or illuminate very weakly.

Remedy

After confirming that green LED's (D4) are illuminating, adjust the output voltage of DC power supply so that the voltage is set to 5.05 volt.

3-2-7-3 Lockout of Keypad.

Symptom

Keys are unable to respond to key operation during program mode or manual mode. The problem involves all the keys in the same row, such as "0", "STATION", "ALL STATION" and "ENDTIME."

Remedy

This occurs when the key top of one of the keys is dislodged from the normal position and held down by being caught on the front panel cutout. Remove the front panel, remove burrs at the cutout, and set the key top at the normal position. See paragraph 4-5-1.

3-2-8 Troubleshooting for the Service Agent.

If there is a malfunction that requires service, DIAGNOSE will flash, an alarm will sound, and the instrument memory will store the appropriate error code, which has been established on the basis of predetermined modes of failure. During automatic operation, the processing timer will stop when DIAGNOSE begins flashing.

By using the error code stored in the memory, a service representative can determine the location of the malfunction. Repair or correction requires MANUAL operation, which is detailed in paragraph 3-4.

3-2-8-1 Readout of Error Codes. When the select magnet is placed on PROGRAM and the AM-PM/DIAGNOSE key is pushed, a code will be displayed in the form E-nn, where n is any digit. If the first code displayed is E-00, then no error code has been stored in the memory. If any other code appears, record it. Repeatedly press AM-PM/DIAGNOSE and record the code displayed, until E-00 appears. Error codes generally appear in the order in which the corresponding malfunctions occurred, but E-03 (power failure) always comes last.

Pressing the OFF/CLEAR key will erase the error codes, but this action is not necessary, since stored codes are cleared by the system before automatic operton begins.

3-2-9 Program Identification.

To identify the EPROM operating system installed in the processor, proceed as follows:

1. Place instrument in manual operating mode.
2. Enter '99' on keyboard.
3. Press VERIFY key.

The program identification will be displayed for two seconds under TIME. It will appear as P-nn.

3-3 LED's ON CONTROL BOARD

There are five groups of LED's on the control board, figure 3-1, which provide troubleshooting information to the serviceman.

3-3-1 Green LED Group.

The six LED's in this group are designated

1	D17
2	D16
3	D18
4	D15
OPEN	D20
CLOSE	D19

The group serves two purposes-to determine the position of the rotary valve at any time, and to detect and identify a defective photosensor.

The station of the rotary valve can be determined from the chart below. Valve OPEN or closed (CLOSE) will also be indicated. If neither OPEN nor CLOSE illuminates, valve rotation has stopped between positions or sensors are defective.

STATION / LED	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1	0	1	0	1	1	0	0	1	0	0	0	0	1	1	1
2	1	1	0	1	0	1	1	0	0	1	0	0	0	0	1	1
3	1	1	1	0	1	0	1	1	0	0	1	0	0	0	0	1
4	1	1	1	1	0	1	0	1	1	0	0	1	0	0	0	0

1 = Illuminated; 0 = Dark

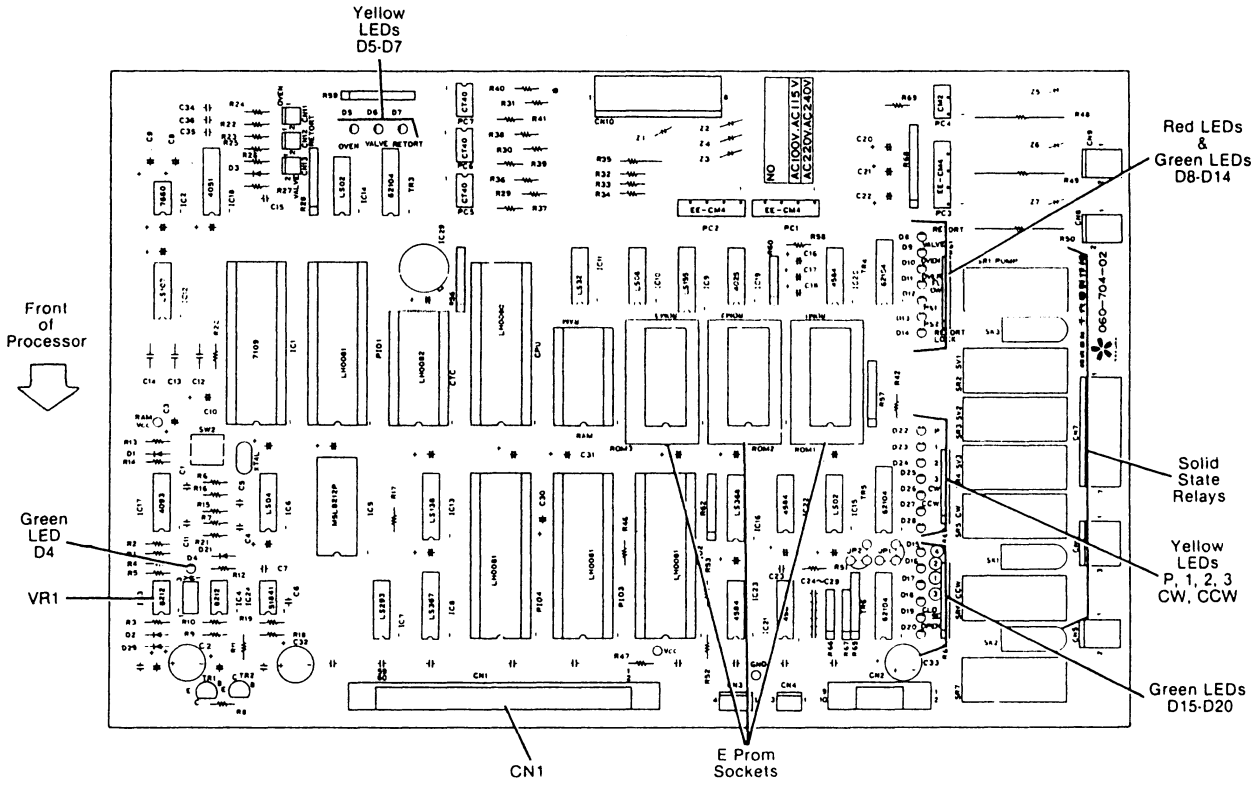


Figure 3-1. Control Board

Identification of a defective photosensor is accomplished as described below. Photosensors 1 through 4 correspond to green LED'S 1 through 4, respectively.

To check photosensors:

1. Place instrument in MANUAL operating mode.
2. Perform manual operation 03, table 3-2.
3. While the valve is rotating, observe the STATION display on the control panel and the green LEDs. If the two indications agree, no photosensor fault exists.

3-3-2 Yellow LED Group.

The six LED's in this group indicate specific pump, solenoid-operated valve, and rotary valve conditions as programmed.

LED ILLUMINATED	EXPECTED ACTION
P	Pump operates.
1	SV1 open
2	SV2 open
3	SV3 open
CW	Rotary valve rotates CW
CCW	Rotary valve rotates CCW

Any part not physically operating as indicated should be investigated for need of repair or replacement.

3-3-3 Mixed Red and Green LED group.

The four red LED's in this group signal troubles; the green LED's indicate normal conditions.

LED ILLUMINATED	SIGNIFICANCE
D8(RED)	Retort overheated, thermal cutout tripped.
D9(RED)	Rotary valve overheated, thermal cutout tripped.
D10(RED)	Oven overheated, thermal cutout tripped.
D11(RED)	Retort overflow has occurred.
D12(GREEN)	Pressure-sensing switch PS1 actuated.
D13(GREEN)	Vacuum-sensing switch PS2 not actuated.
D14(GREEN)	Retort interlock is closed.

3-3-4 Yellow LED Group.

The three LED's in this group illuminate when heaters in the oven, rotary valve, and retort are operating. Failure of one of these LED's to illuminate does not necessarily indicate trouble. The corresponding unit may be at its selected temperature, and heating is not being demanded by the temperature control program. Check with D10, D9, D8.

3-3-5 Single Green LED D4.

This LED is normally illuminated except in the case of power failure. It indicates that the power failure threshold has been set properly.

3-4 MANUAL OPERATION

The manual operation chart, table 3-2, provides instructions for performing any single processing operation manually, after placing the select magnet at the MANUAL position on the control board.

3-4 MANUAL OPERATION

3-4-1 Manual Mode Display.

When the select magnet is attached to MANUAL, the manual operation can be started. LED's will display the station number, the manual number and the temperature as indicated in Figure 3-2. If the manual mode is not displayed after placing the select magnet on MANUAL, release and relock the retort interlock slide.

3-4-2 Manual Operation Chart.

The manual operation chart, table 3-2, provides instructions for performing any single processing operation manually.

NOTE: Manual operations 01 through 03 in the chart may be performed by the operator.

To perform manual operations:

1. Place select magnet on MANUAL.
2. Unlock and relock retort interlock slide.
3. Press desired operation number on keyboard.
4. Press ON/ENTER.

To return to clock operation, remove magnet from MANUAL.

NOTE: The manual operations described in the balance of this table should not be performed by operators. They are only for use by the service representatives.

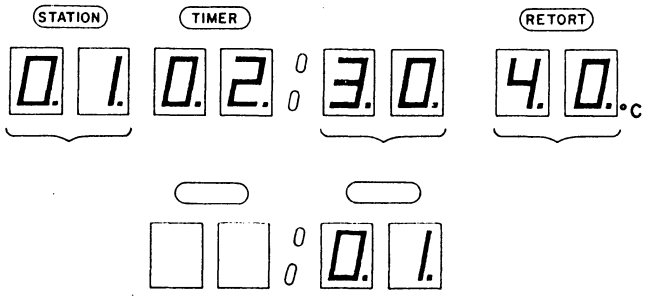


Figure 3-2. Manual Mode Display

1. Place select magnet on MANUAL.
2. Unlock and relock retort interlock slide.
3. Press desired operation number on keyboard.
4. Press VERIFY.
5. Press ON/ENTER.
6. To stop an operation which does not stop automatically, press OFF/CLEAR.
7. When pressing VERIFY, "——" displays before operation number.

To return to clock operation, remove magnet from MANUAL.

3-4-3 Functions Using Manual Commands.

Pressure/Vacuum and pump-in actions can be started by activating solenoid-operated valves and air pump with the following manual commands.

CAUTION

During these operations, safety devices do not work.

1. Vacuum during P/V cycle.
   1. Place select magnet on MANUAL.
   2. Key in Manual number 05, press VERIFY and then press ON/ENTER (=Close rotary valve). When the rotary valve is closed, this step is not required.
   3. Key in Manual number 07, press VERIFY and then press ON/ENTER (=SV1 Activation).
   4. Key in Manual number 06, press VERIFY and then press ON/ENTER (=Air Pump Function).
   5. To stop the operation, press OFF/CLEAR (=SV1 and Air Pump stop).
2. Vacuum during Pump-In.
   1. Place select magnet on MANUAL.
   2. Key in Manual number 05, press VERIFY and then press ON/ENTER (=Close Rotary Valve) If the rotary valve is closed, this step is not required.
   3. Key in manual number 07, press VERIFY and then press ON/ENTER (=SV1 Activation).
   4. Key in manual number 09, press VERIFY and then press ON/ENTER (=SV3 Activation).
   5. Key in manual number 06, press VERIFY and then press ON/ENTER (=Air Pump Function).
   6. To stop the operation, press OFF/CLEAR (=SV1, SV3 and Air Pump stop). If manual number 04 is commanded instead of 05 in Step 2, solution can be transferred to retort.
3. Pressure.
   1. Place select magnet on MANUAL.
   2. Key in manual number 05, press VERIFY and then press ON/ENTER (=Close Rotary valve). If the rotary valve is closed, this step is not required.
   3. Key in manual number 08, press VERIFY and then press ON/ENTER (=SV2 Activation).
   4. Key in manual number 09, press VERIFY and then press ON/ENTER (=SV3).
   5. Key in manual number 06, press VERIFY and then press ON/ENTER (=Air Pump Function).
   6. To stop the operation, press OFF/CLEAR (=SV2, SV3 and Air Pump stop).
4. Pump Out.
   1. Place select magnet on MANUAL.
   2. Key in manual number 05, press VERIFY and then press ON/ENTER (=Close Rotary valve). If the rotary valve is closed, this step is not required.
   3. Key in manual number 08, press VERIFY and then press ON/ENTER (=SV2 Activation).
   4. Key in manual number 09, press VERIFY and then press ON/ENTER (=SV3 Activation).
   5. Key in manual number 06, press VERIFY and then press ON/ENTER (=Air Pump Function).

      The pressure will rise above 0.2 kg/cm², and the pressure switch will switch on.
   6. Key in manual number 04, press VERIFY and then press ON/ENTER (=Open Rotary Valve).

      Solution transfer will be completed, and bubbling will occur in the reservoir).
   7. Press OFF/CLEAR (=SV2, SV3, and Air Pump stop).
   8. Key in manual number 05, press VERIFY and then press ON/ENTER (=Close Rotary Valve).

3-4-4 Cautions.

3-4-4-1 If the select magnet is removed from MANUAL during some manual operations, the instrument will stop and return to clock operation.

3-4-4-2 If the select magnet is removed during Pump-Out (01), Pump-In (02), Station (03, 21), Rotary Valve Open (04), Rotary Valve Close (05) or Station Reverse (22), the instrument will not stop and will not return to the clock function until each operation is completed.

In order to stop these operations, retort interlock slide should be released and relocked after removing select magnet from MANUAL position, so that instrument will return to clock function.

3-4-4-3 If the alarm buzzer sounds during manual operation, correct the problem and then release and relock retort interlock slide, so that the manual operation can be done from the beginning.

Table 3-1. Troubleshooting

ERROR CODE	SYMPTOM	PROBABLE CAUSE	REMEDY	REMARKS
01	Retort overflow occurred during P/V cycle. (Trap was filled with solution).	1. Reservoir overfilled. 2. Specimen volume in excess. 3. Solution (especially Chloroform evaporated. 4. Sensor adjustment incorrect. 5. Sensor or trap touched by hand.	1. Reduce volume in reservoir. 2. Reduce specimen volume to less than the specified volume. 3. Skip P/V cycle at the solution (especially Chloroform) station and the first paraffin station. 4. Adjust sensor. (See paragraph 2-3-3.) After the above procedures have been performed, pump-out shall be done by manual operation and the solution in the trap shall be returned to the retort. After that, the trap should be removed and thoroughly cleaned together with the tube connecting the retort to the overflow trap. (See paragraph 2-1-1-2.)	Buzzer sounds for 30 seconds, DIAGNOSE flashes. Disconnect overflow tube heater at terminals 1 & 2 behind oven. Cut cable ties as necessary. Restore when reassembling.
02	Retort overflow occurred other than during pump in or P/V cycle.	1. Sensor adjustment incorrect. 2. Sensor or trap touched by hand. 3. The instrument was moved with the retort filled with solution.	1. Adjust sensor. (See paragraph 2-3-3.) After the above procedure has been performed, pump-out shall be done by manual operation and the solution in the trap shall be returned to the retort. After that, the trap should be removed and thoroughly cleaned together with the tube connecting the retort to the overflow trap. (See paragraph 2-1-1-2.)	Disconnect overflow tube heater at terminals 1 & 2 behind oven. Cut cable ties as necessary. Restore when reassembling.
03	Power failure	1. Power failure. 2. Plug pulled from power receptacle. 3. Circuit breaker open due to internal short circuit. 4. Circuit breaker open due to leakage current exceeding 30 mA.	 2. Restore plug to receptacle. 3. Reset circuit breaker. 4. Reset circuit breaker. CAUTION If circuit breaker opens again shortly after resetting, do not reset again. Investigate cause, and take applicable correction action.	POWER OUT flashes when power is recovered. Process will resume. 3. Refer to wiring diagrams. 4. Refer to wiring diagrams Disconnect overflow tube heater at terminals 1 & 2 behind oven. Cut cable ties as necessary. Restore when reassembling.
10	The retort overflowed during pump-in. (Solution was mixed with the next one.)	1. Reservoir overfilled. 2. Specimen volume in excess. 3. The next solution was pumped in to the retort still filled with solution due to incomplete pump-out.	1. Reduce volume in reservoir. 2. Reduce specimen volume to less than the specified volume. 3. Disassemble P type regulator to clean the valve and "P" ring. Then, adjust operating pressure. If "O" ring is worn out, replace it with new one. (See paragraph 2-2-1-2.) After the above procedures have been performed, pump-out shall be done by manual operation and the solution in the trap shall be returned to the retort. In case of paraffin, the trap should be removed and thoroughly cleaned together with the tube connecting the retort to the overflow trap.	Unscrew trap tc remove.

Table 3-1. Troubleshooting (Continued)

ERROR CODE	SYMPTOM	PROBABLE CAUSE	REMEDY	REMARKS
11	Pump-in not complete after the lapse of 6 minutes.	1. Air line blocked.	1. Clean air line.	In case of no solution in the retort, the cause may be clogging in the fluid pa If some s ion has entered retort, the cause may be the pressure switch.
		2. Solution line clogged.	2. Clean solution line. In case of clogging station 15 line, replace Xylene for cleaning with fresh Xylene.	
		3. Rotary valve clogged.	3. Clean rotary valve.	
		4. Setting of the pressure switch (PS2) at the vacuum side was incorrect. (ON pressure was too high.)	4. Adjust the setting of the pressure switch (PS2) as 12cmHg for ON, 14cmHg for OFF.	
		5. The lead wire of the pressure switch was disconnected from the terminal.	5. Connect to terminal plate.	When PS2 is ON, D13 will illuminate.
		6. The detector circuit for PS2 malfunctioned.	6. Replace the control P.C. board. (See paragraph 4-5-2.)	
12	Pump-in did not complete with 3 time trials (6 minutes each).	1. Air line blocked.	1. Clean air line. (See paragraph 2-1-1, 2-2-1.)	In case of no solution in the retort, the cause may clogging in the fluid path. If some solution has entered retort, the cause may be the pressure switch.
		2. Solution line clogged.	2. Clean solution line. In case of clogging Station 15 line, replace Xylene for cleaning with new one.	
		3. Rotary valve clogged.	3. Clean rotary valve.	
		4. Setting of the pressure switch (PS2) at the vacuum side incorrect. (ON pressure was too high.)	4. Adjust the setting of the pressure switch (PS2) as 12cmHg for ON, 14cmHg for OFF.	
		5. The lead wire of the pressure switch was disconnected from the terminal plate.	5. Connect to terminal plate.	When PS2 is ON, D13 will illuminat
		6. The detector circuit for PS2 malfunctioned.	6. Replace the control P.C. board. (See paragraph 4-5-2.)	
13	Retort pressure could not be reduced (more than 14cmHg) nor pressurized (more than 0.2kg/cm²).	1. Air line union loose.	1. Tighten the union. (See paragraph 4-8-1.)	
		2. Air leaked through the gasket of the retort.	2. Replace the gasket. (See paragraph 4-7-7.)	
		3. Manual latch of the retort loose.	3. Adjust cam lock to firmly lock the retort lid. (See paragraph 4-7-8.)	
		4. Air leaked from the air line.	4. Check and repair the air line as required. (See paragraph 2-2-1.)	
		5. Air pump malfunction.	5. Repair the pump. (See paragraph 4-9-2.)	5. See paragraphs 4-9-2.
		6. Solenoid-operated valve malfunction.	6. Replace the solenoid-operated valve. (See paragraph 4-9-3.)	
		7. Connector 7 or Connector 8 was disconnected or loose.	7. Connect the connectors firmly.	
		8. Solid state relay malfunction.	8. Replace the solid state relay or the control P.C. board. (See paragraph 4-5-2.)	
14	FLUID LOW occurred.	1. No solution or paraffin in the reservoir or the container.	1. Fill the reservoir or the container.	FLUID LOW illuminates. DIAGNOSE does not flash.
		2. Reservoir not properly set in the reagent reservoir rack.	2. Insert reservoir in rack properly.	
		3. V type regulator malfunctioned or set incorrectly. (Set pressure was too high.)	3. Disassemble V type regulator to clean valve and "O" ring, and adjust as 20cmHg. (See paragraph 2-2-1-4.)	

Table 3-1. Troubleshooting (Continued)

ERROR CODE	SYMPTOM	PROBABLE CAUSE	REMEDY	REMARKS
14 (Continued)		4. Setting of the pressure switch (PS2) at the vacuum side was incorrect. (OFF pressure was too low.)	4. Adjust the setting of the pressure switch (PS2) as 12cmHg for ON, 14cmHg for OFF. (See paragraph 2-2-1-3.)	
		5. Pressure switch (PS2) defective.	5. Replace pressure switch (PS2). (See paragraph 2-2-1-3.)	When PS2 is ON, D13 will illuminate.
		6. Detector circuit for PS2 malfunctioned.	6. Replace control P.C. board. (See paragraph 4-5-2.)	
20	The retort pressure has not reached the set pressure within one minute pressurization after closing the rotary valve.	1. Air line union loose.	1. Tighten the union. (See paragraph 4-9-1.)	The operating pressure of relief valve 2 should be at least 0.1 kg/cm² higher than that of PS1.
		2. Air leaked through the gasket of the retort.	2. Replace the gasket. (See paragraph 4-7-7.)	
		3. The manual latch of the retort was loose.	3. Adjust cam lock to firmly lock the retort lid. (See paragraph 4-7-8.)	
		4. Air leaked from the air path.	4. Check and repair the air line as required. (See paragraph 2-2-1.)	
		5. Air pump malfunction.	5. Repair the pump. (See paragraph 4-9-2.)	5. See paragraph 4-9-2.
		6. Solenoid-operated valve malfunction.	6. Replace the solenoid operated valve. (See paragraph 4-9-3.)	
		7. Solid state relay.	7. Replace the solid state relay or the control P.C. board. (See paragraph 4-5-2.)	
		8. P type regulator set incorrectly. (Set pressure was too low.)	8. Adjust the set pressure of the P type regulator as 0.35kg/cm². (See paragraph 2-2-1-5.)	The set pressure of P type regulator should be higher than that of PS1.
		9. Setting of the pressure switch (PS1) at the pressure side was incorrect. (ON pressure was too high.)	9. Adjust the setting of the pressure switch (PS1) as 0.2kg/cm² for ON, 0.15kg/cm² for OFF. (See paragraph 2-2-1-2.)	
		10. The pressure switch (PS1) defective.	10. Replace the pressure switch (PS1). (See paragraph 2-2-1-2.)	
		11. The detector circuit for the pressure switch PS1 malfunctioned.	11. Replace the control P.G. Board. (See paragraph 4-5-2.)	
		12. Connector 7 or connector 8 was discontinued or loose.	12. Connect the connectors firmly.	
21	The retort pressure has not reached the set pressure after 3 times pressurization (one minute each after closing the rotary valve.)	Same as in 20.	Same as in 20.	
22	Pump out not complete 6 minutes after opening the rotary valve.	1. Air path union loose.	1. Tighten the union.	
		2. Setting of the pressure switch (PS1) at the pressure side was incorrect. (OFF pressure was too high.)	2. Adjust the setting of the pressure switch (PS1) as 0.2kg/cm² for ON, 0.15kg/cm² for OFF. (See paragraph 2-2-1-2.)	
		3. The pressure switch (PS1) defective.	3. Replace the pressure switch (PS1). (See paragraph 2-2-1-2.)	

Table 3-1. Troubleshooting (Continued)

ERROR CODE	SYMPTOM	PROBABLE CAUSE	REMEDY	REMARKS
22 (Continued)		4. The detector circuit for PS1 malfunctioned.	4. Replace the control P.C. Board. (See paragraph 4-5-2.)	
		5. Piping clogged (Inside pipes, tubing).	5. Replace or clean the piping. (See paragraph 2-2-1, 4-12-1.)	
		6. Rotary valve clogged internally.	6. Clean the rotary valve. (See paragraph 4-10-4.)	6. See Paragraph 4-10 For disassembly instructions.
		7. Paraffin solidified in the retort.	7. Heat the retort by manual operation. When paraffin has been melted, it can be pumped out. Then, proceed to the clean cycle.	
23	Pump-out not complete after 2 trials (6 minutes each.)	Same as in 22.	Same as in 22.	
30	Manual Resettable Temperature Protective devices open (oven, rotary valve or retort).	1. Triac defective.	1. Replace triac.	
		2. Photothyristor defective.	2. Replace Photothyristor or replace the Control P.C. board. (See para. 4-5-2.)	
		3. Heater circuit shorted.	3. Repair or replace the shorted part.	
		4. Thermistor defective.	4. Replace thermistor. (See paragraph 4-10-7, 4-7-3, 4-8-3.)	
		5. Temperature control circuit defective.	5. Replace the control P.C. Board. (See paragraph 4-5-2.)	
		6. 80°C thermal fuse defective.	Replace 80° thermal fuse. (See paragraph 4-10-6-, 4-10-7, 4-7-5, 4-7-4, 4-8-4, 4-8-5.)	
		7. Connector 10 disconnected.	7. Connect connector 10 firmly.	
31	Thermistor for the paraffin oven open.	1. Connector 11 disconnected.	1. Connect connector 11 firmly.	Temperature display indicates 99°C
		2. Pin for Connector 11 disconnected.	2. Insert the pin firmly.	
		3. Thermistor lead open.	3. Connect thermistor lead.	
		4. Thermistor open.	4. Replace thermistor. (See paragraph 4-8-3.)	
32	Thermistor for the rotary valve open.	1. Connect 13 disconnected.	1. Connect connector 13 firmly.	
		2. Pin for Connector 13 disconnected.	2. Insert the pin firmly.	
		3. Thermistor lead open.	3. Connect thermistor lead.	
		4. Thermistor open.	4. Replace themistor. (See paragraph ?????.)	
33	Retort thermistor open.	1. Connector 12 disconnected.	1. Connect connector 12 firmly.	
		2. Pin for Connector 12 disconnected.	2. Insert the pin firmly.	
		3. Thermistor lead open.	3. Connect thermistor lead.	
		4. Thermistor open.	4. Replace thermistor. (See paragraph 4-7-3.)	

Table 3-1. Troubleshooting (Continued)

ERROR CODE	SYMPTOM	PROBABLE CAUSE	REMEDY	REMARKS
34	Failure of paraffin oven temperature control. (Temperature too high).	1. Traic defective.	1. Replace triac.	
		2. Photothyristor defective.	2. Replace the photothyristor, or replace the control P.C. Board. (See paragraph 4-5-2.)	
		3. Heater circuit shorted.	3. Repair the short.	
		4. Thermistor defective.	4. Replace thermistor. (See paragraph 4-8-3.)	
		5. Temperature control circuit defective.	5. Replace control P.C. Board. (See paragraph 4-5-2.)	
		6. Ambient temperature higher than set temperature.	6. Move the instrument to a room with temperature between 10°C and 40°C.	
35	Failure of paraffin oven temperature control. (Temperature too low.)	1. Triac defective	1. Replace triac.	
		2. Photothyristor defective.	2. Replace photothyristor or replace the Control P.C. board. (See paragraph 4-5-2.).	
		3. The heater circuit open.	3. Replace heater. (See paragraph 4-8-2.)	
		4. Thermal cutout tripped.	4. Reset the thermal cutout.	4. E-30 is als stored.
		5. Thermistor circuit open.	5. Repair thermistor circuit.	5. Temperatu display is 99.
		6. Thermistor open or defective.	6. Replace thermistor. (See paragraph 4-8-3.)	6. Termperatu display is 99.
		7. Thermistor circuit shorted.	7. Repair the short.	7. Temperatu display is 98.
		8. cold solution standing in the retort more than 10 minutes.	8. Advise operator not to pour cold solutions directly into retort.	
36	Failure of rotary valve temperature control. (Temperature too high.)	Same as in 34.	Same as in 34.	
37	Failure of rotary valve temperature control. (Temperature too low.)	Same as in 35.	Same as in 35.	
38	Failure of retort temperature control. (Temperature too high.)	Same as in 34.	Same as in 34.	
39	Failure of retort temperature control. (Temperature too low.)	1. Triac defective.	1. Replace triac.	
		2. Photothyristor defective.	2. Replace Photothyristor or replace the Control P.C. board. (See paragraph 4-5-2.)	
		3. The heater circuit open.	3. Replace the heater. (See paragraph 4-7-2.)	
		4. Thermal cutout tripped.	4. Reset the thermal cutout.	4. E-30 is al stored.
		5. Thermistor circuit open.	5. Repair thermistor circuit.	5. Temperatı display is 0(
		6. Thermistor open or defective.	6. Replace thermistor. (See paragraph 4-7-3.)	6. Temperatı display is 0(

Table 3-1. Troubleshooting (Continued)

ERROR CODE	SYMPTOM	PROBABLE CAUSE	REMEDY	REMARKS
39 (Continued)		7. Thermistor circuit shorted.	7. Repair the shorted part.	7. Temperature display is 99.
		8. Cold solution standing in the retort more than 10 minutes.	8. Advise operator not to pour cold solutions directly into retort.	
40	Rotary valve does not move from the closed position (start position within 9 seconds.)	1. Connector 6 or connector 8 disconnected.	1. Connect connectors firmly.	
		2. Rotary valve did not rotate due to clogging.	2. Clean the rotary valve. (See paragraph 4-10-4.)	
		3. Motor wire disconnected from terminal block.	3. Connect motor wire to terminal block firmly. (See paragraph 4-10-4.)	
		4. Ceramic parts of rotary valve stuck together and did not move.	4. Clean ceramic parts of rotary valve. (See paragraph 4-10-4.)	See paragraph 4-10 for required disassembly instructions
		5. Coupling between rotary valve and motor shifted.	5. Attach the coupling firmly. (See paragraph 4-10-1.)	
		6. Motor defective.	6. Replace motor. (See paragraph 4-10-2.)	
		7. Solid state relay defective.	7. Replace solid state relay (control P.C. board). (See paragraph 4-5-2.)	
		8. Photointerrupter for position detection defective.	8. Replace photointerrupter P.C. board. (Rotary valve P.C. board replacement.) (See paragraph 4-10-3.)	D15 to D20 displays the operating condition of each photoir upter.
		9. Positioning disc broken.	9. Replace positioning disc. (See paragraph 4-10-3.)	
		10. Photointerrupter for position detection disturbed by strong light from outside.	10. Eliminate such light.	
41	Rotary valve did not reach open position from closed position within 9 seconds.	1. Connector 2, connector 6 or connector 8 disconnected.	1. Connect connectors firmly.	
		2. Motor wire disconnected from terminal block.	2. Connect motor wire to terminal block firmly.	
		3. Ceramic parts of rotary valve stuck together and did not move.	Clean ceramic parts of rotary valve. (See paragraph 4-10-4.)	
		4. Coupling between rotary valve and motor shifted.	4. Fix the coupling firmly. (See paragraph 4-10-1.)	
		5. Motor defective.	5. Replace motor. (See paragraph 4-10-2.)	
		6. Solid state relay defective.	6. Replace solid state relay (control P.C. board). (See paragraph 4-5-2.)	
		7. Photointerrupter for position detection defective.	7. Replace photointerrupter P.C. board. (Rotary valve P.C. board replacement) (See paragraph 4-10-3.)	

Table 3-1. Troubleshooting (Continued)

ERROR CODE	SYMPTOM	PROBABLE CAUSE	REMEDY	REMARKS
41 (Continued)		8. Rotary valve did not rotate due to clogging.	8. Clean rotary valve. (See paragraph 4-10-4.)	
		9. Positioning disc stained with gear head oil or particles of dust.	9. Clean positioning disc.	
		10. Photointerrupter for position detection stained with gear head oil.	10. Clean or replace rotary valve P.C. board. (See paragraph 4-10-3.)	
50	Rotary valve does not move from closed position (start position) within 9 seconds.	Same as in 40.	Same as in 40.	
51	Error for closed position and open position detected simultaneously.	1. Photointerrupter for position detection defective.	1. Replace photointerrupter P.C. board. (Rotary valve P.C. board replacement.) (See paragraph 4-10-3.)	
		2. Positioning disc broken.	2. Replace positioning disc. (See paragraph 4-10-3.)	
		3. Photointerrupter for position detection disturbed by strong light from outside.	3. Eliminate such light.	
		4. Photointerrupter input circuit defective.	4. Replace the control P.C. board. (See paragraph 4-5-2.)	
52	Rotary valve did not reach open position from closed position within 9 seconds.	Same as in 41.	Same as in 41.	
53	Rotary valve moved from the closed position (start position) to the next closed position, skipping the open position.	1. Photointerrupter for open position detection defective.	1. Replace photointerrupter (Rotary valve P.C. board replacement.) (See paragraph 4-10-3.)	
		2. The photointerrupter input circuit defective.	2. Replace control P.C. Board. (See paragraph 4-5-2.)	
		3. Positioning disc broken.	3. Replace positioning disc. (See paragraph 4-10-3.)	
		4. Positioning disc stained with gear head oil or particles of dust.	4. Clean positioning disc.	
		5. Connector 2 disconnected.	5. Connect connector 2 securely.	
		6. Photointerrupter for position detection stained with gear head oil.	6. Clean or replace rotary valve P.C. board. (See paragraph 4-10-3.)	
60	Rotary valve does not move from the open position after the lapse of 9 seconds.	Same as in 40.	Same as in 40.	
61	Error signals for the open position and the closed position detected simultaneously.	Same as in 51.	Same as in 51.	
63	Rotary valve moves from open position to next open position, skipping closed position.	Same as in 53.	Same as in 53.	

Table 3-1. Troubleshooting (Continued)

ERROR CODE	SYMPTOM	PROBABLE CAUSE	REMEDY	REMARKS
64	Rotary valve does not reach closed position from nearest open position within 9 seconds.	Same as in 40.	Same as in 40.	
65	Rotary valve does not reach the closed position from nearby the closed position within 9 seconds.	Same as in 40.	Same as in 40.	
66	Rotary valve does not move from the closed position within 9 seconds.	Same as in 40.	Same as in 40.	
67	Rotary valve moved from closed position to the next closed position, skipping the open position.	Same as in 53.	Same as in 53.	
70	Rotary valve does not move from the closed position within 9 seconds.	Same as in 40.	Same as in 40.	
71	Error signals for the open position and the closed position detected simultaneously.	Same as in 51.	Same as in 51.	
72	Rotary valve does not reach open position from closed position within 9 seconds.	Same as in 40.	Same as in 40.	
73	Rotary valve does not stop at the required station after 2 times rotation.	1. Photointerrupter for position detection defective. 2. Positioning disc broken. 3. Photointerrupter for position detection disturbed by strong light source. 4. Connector 2 disconnected.	1. Replace photointerrupter P.C. Board (Rotary valve P.C. board replacement (See paragraph 4-10-3.) 2. Replace positioning disc. (See paragraph 4-10-3.) 3. Eliminate light source. 4. Connect connector 2 securely.	
74	Rotary valve does not stop at the required station with one time rotation.	Same as in 73.	Same as in 73.	This may occu only at the first rotary valve check before starting the automatic operation.

Table 3-2 Manual Operation Chart

MANUAL OPERATION NO.	FUNCTION NAME	PROCESSOR FUNCTION	REMARKS
00	Paraffin temperature lowest limit expansion.	Refer to Operating Instructions.	The lowest limit is changed between 45 °C and 70 °C.
01	Pump-Out	The solution in the retort is transferred to the reservoir.	If any condition of 1 through 4 below exists, pump-out will not function, and the buzzer will sound. If any two conditions of 2 through 4 below exist simultaneously, STANDBY flashes. 1. The retort interlock has not been set. 2. At stations 11-13, STANDBY flashes. 3. At stations 11-13, the temperature of the rotary valve is lower than 70 °C. 4. At Stations 11-13, the temperature of the retort is lower than the set temperature.
02	Pump-In	The solution in the reservoir is transferred to the retort.	If any condition of 1 through 5 below exists, pump-in will not function and the buzzer will sound. If any two conditions of 2 through 4 below exist simultaneously, STANDBY flashes. 1. The retort interlock has not been set. 2. At Stations 11-13, STANDBY is flashing. 3. At Stations 11-13, the temperture of the rotary valve is lower than 70 °C. 4. At Stations 11-13, the temperature of the retort is lower than the set temperature. 5. The retort overflow trap contains solution and the sensor functions.
03	Station Advance	The rotary valve advances to the next higher numbered station.	If any of the conditions of 1 through 3, below, exists, the rotary valve does not advance, and the buzzer sounds. 1. The retort interlock has not been set. 2. Solution is in the retort. 3. At Station 13, paraffin remains in the retort.
04	Open Rotary Valve	The Rotary valve is at the open position.	The rotary valve does not move to the open position and the buzzer sounds unless the retort interlock has been set.
05	Close Rotary Valve	The rotary valve is at the closed position.	The rotary valve does not move to the closed position and the buzzer sounds unless the retort interlock has been set.

Table 3-2 Manual Operation Chart (Continued)

MANUAL OPERATION NO.	FUNCTION NAME	PROCESSOR FUNCTION	REMARKS
06	Pump Function	The air pump starts functioning.	The air pump does not function and the buzzer sounds unless the retort interlock has been set. To stop the pump, push the OFF/CLEAR button.
07	SV 1 Activation	Solenoid-operated valve (SV1) is activated.	The SV1 is not activated unless the retort has been set. Press OFF/CLEAR to stop valve action.
08	SV 2 Activation	Solenoid-operated valve (SV2) is activated.	The SV2 is not activated unless the retort interlock has been set. Press OFF/CLEAR to stop valve action.
09	SV 3 Activation	Solenoid-operated valve (SV3) is activated.	The SV3 is not activated unless the retort interlock has been set. Press OFF/CLEAR to sto valve action.
10	Inhibition of External Alarm	External alarm output is inhibited.	When MANUAL mode is released external alarm is available.
20	STANDBY off	STANDBY condition is removed. Instrument is in ready condition.	The buzzer sounds unless the temperature of the oven is higher than the paraffin temperature lower limit. With this operation, processing can be started without stand-by period. CAUTION: Do not perform this operation before paraffin is completely melted.
21	Station Advance	The rotary valve advances to the next higher numbered station.	Same function as Manual No. 03 except that it can be performed even when retort is filled with solution or paraffin remains in the retort.
22	Station Reverse	Rotary valve moves to next lower numbered station.	If retort interlock has not been set, buzzer will sound, and operation will not be performed. As in Manual Operation 21, operation can be performed even when retort is filled with solution or paraffin remains in retort.
23	Rotary Valve C.C.W. Rotation	The rotary valve rotates counterclockwise continuously.	To stop rotation, press OFF/CLEAR. Rotation will stop at a random station, and station display will be incorrect. To obtain correct station number display perform manual operation 04 or 05. This operation may be performed even when retort is filled with solution or paraffin remains in retort.
24	Rotary Valve C.W. Rotation	The rotary valve rotates clockwise continuously.	To stop rotation, press OFF/CLEAR. Rotation will stop at a random station, and station display will be incorrect. To obtain correct station number display perform manual operation 04 or 05. This operation may be performed even when retort is filled with solution or paraffin remains in retort.
35-70	Retort Heating	The retort will heat rapidly.	Heating should be stopped when retort temperature reaches programmed temperature. To stop heating press VERIFY, then press OFF/CLEAR. Heating action cannot be stopped at stations 11 through 13.
99	Program Code Display	Program Code is displayed under TIMER for 2 seconds as "P3-nnn-nn."	After displaying program code manual operation number will be changed to 01.

SECTION 4 DISASSEMBLY, REPAIR, AND REPLACEMENT

4-1 INTRODUCTION

This section provides detailed instructions for removal, disassembly, and replacement of TISSUE-TEK 1000/2000/3000 V.I.P. components. Troubleshooting procedures in Section 3 identify parts which require replacement. Replacement parts are listed in Section 5.

WARNING

Always turn off instrument power and unplug line cord before removing an assembly.

CAUTION

Do not disassemble the instrument further than necessary for access to the part to be removed.

CAUTION

Valve seats and O-rings used in this instrument are Kalrez or Viton. The ring seal in the rotary valve assembly is Viton. These materials have been selected for their compatibility with tissue processing solutions. Never use substitute parts. Use replacements listed in Section 5 only. When no specific instructions are given, reassembly is the reverse of diassembly.

4-1-1 Tools Required.

The tools listed below are required for servicing the Tissue-Tek V.I.P. 1000/2000/3000. The list is not complete. Only essential tools peculiar to the processor are listed. Except crescent wrenches, ALL TOOLS SHOULD BE METRIC.

1/4" drive, hex socket wrench set
Open-end wrench set
Phillips screwdriver set
Allen wrench set
Feeler gauge
Adjustable crescent wrench (8 inches long)
Adjustable crescent wrench (10 inches long)

4-1-2 General Procedure.

Disassembly, repair and replacement shall be done in the following order (except for Battery Replacement).

1. Record the error code.
2. Record user's processing programs stored in memory.
3. Open retort lid and confirm that no solution remains in retort. If solution remains, it should be pumped out by manual operation.
4. Transfer paraffin in paraffin oven to a paraffin bath, so that paraffin will not solidify.
5. Confirm that battery switch is in ON position.
6. Turn off power switch and unplug line cord from the receptacle.
7. Disassemble, repair, and adjust the instrument.
8. Plug in line cord and turn on power switch.
9. Perform test run.
10. Key in the user's processing programs.
11. Accurately enter the current time into the instrument.
12. If STANDBY is flashing, eliminate it by manual operation (Manual Number 20) after confirming that paraffin is melted.

4-2 REAR COVER REMOVAL (CONTROL BOX)

Removal of the rear cover is required for access to fuses and electronic printed circuit boards (CCU-1, CCU-3). To remove the cover, remove four screws which fasten it in place, and slide the cover over the power cord, Figure 4-1.

4-3 FUSE REPLACEMENT

CAUTION

Never replace a fuse with one of a different rating. Verify correct rating of the replacement fuse.

WARNING

Shut off power to instrument before replacing fuse.

Tools required: (+) screwdriver.

1. Power off the instrument.
2. Remove the control box cover. See figure 4-1. The fuseholder is left (rear view) of the power switch.
3. Unscrew fuseholder cap and remove fuse from its receptacle. Insert new fuse into fuseholder.
4. Attach control box cover.
5. Power on the instrument. If a replacement fuse blows immediately after restoring power, do not replace it a second time without determining the cause. Refer to Electrical Wiring Diagram, Figure 6-1.

4-4 REPLACEMENT OF FRONT PANEL

Tools required: (t) screwdriver, box driver 5.5 mm.

1. Remove control box cover. See figure 4-1.
2. Disconnect connector CN1.
3. Remove two screws which fasten control box. See figure 4-2.
4. Pull box toward rear of instrument and lift off. See figure 4-2.
5. Remove upper panel plate and lower panel plate from control box. See figure 4-3.
6. Remove screws which fasten handles to both side frames of box. Release display panel unit. See figure 4-3.
7. Remove upper panel plate and lower panel plate from display panel unit.
8. Lay display panel so that panel PC board is face up. Remove screws and washers holding board and remove keypads.

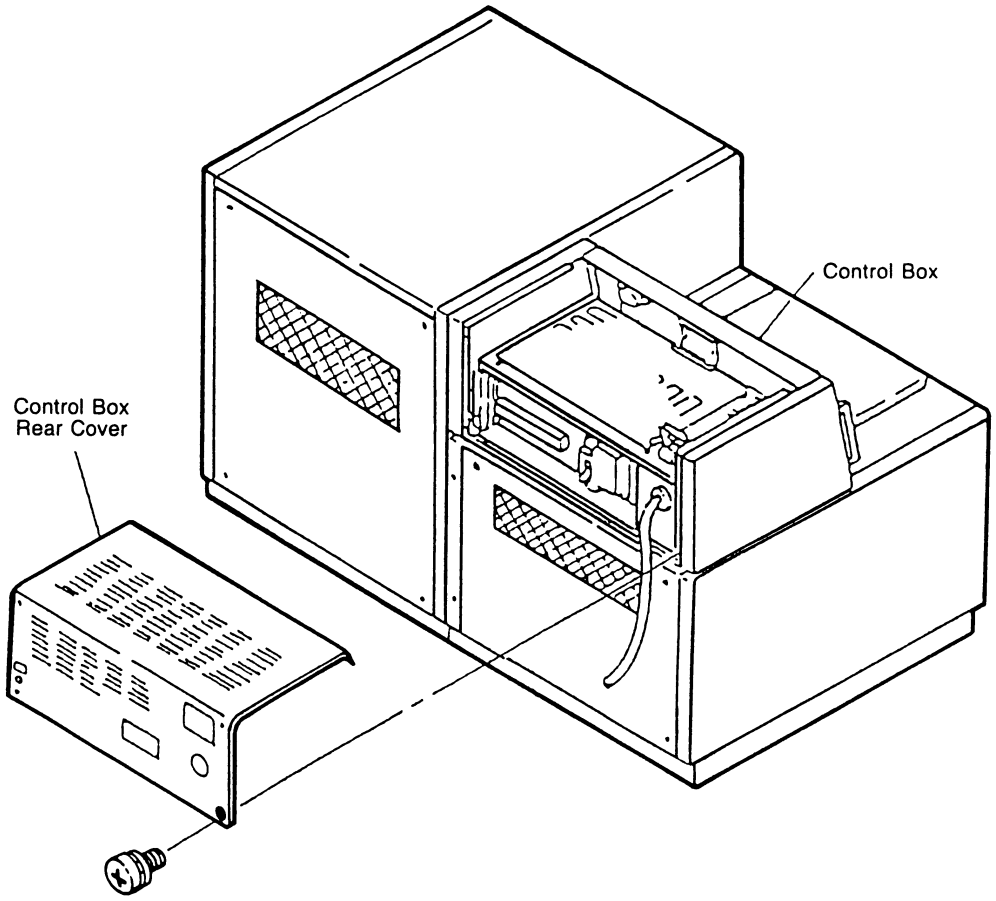


Figure 4-1. Control Box Cover

9. Insert keypads into openings of new panel.
10. Fasten panel PC board temporarily to check alignment of board with display panel windows.
11. After confirming proper alignment, fasten panel PC board firmly.
12. Fasten upper and lower panel plates to panel unit and then attach panel unit to control box together with both side handles.
13. Fasten upper and lower panel plates to control box.
14. Install control box from top of power chassis. CN1 connector should go over control PC board.
15. Pull control box toward the front and fasten it with two screws. See figure 4-2.
16. Connect CN1 connector to control PC board.
17. Attach control box cover. See figure 4-1.

Note: Take care to avoid scratching display panel overlay. Panel overlay is made of plastic film.

4-5 REPLACEMENT OF CIRCUIT BOARDS

4-5-1 Replacement of Front Panel PC Board.

Tools required: (+) screwdriver, box driver 5.5 mm

1. Remove control box cover. See figure 4-1.
2. Disconnect connector CN1.
3. Remove two screws which fasten control box. See figure 4-2.
4. Pull box toward rear of instrment and lift off. See figure 4-2.

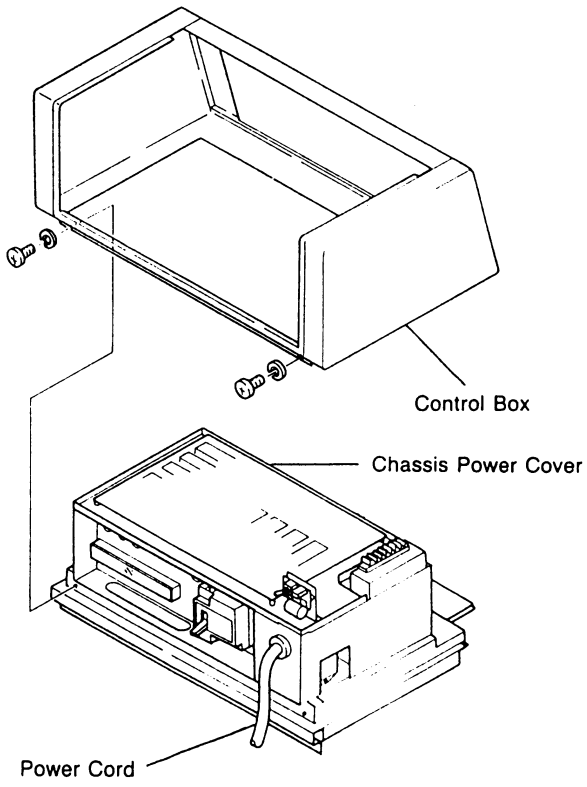


Figure 4-2. Control Box and Chassis, Rear Vie

5. Remove upper panel plate and lower panel plate from control box. See figure 4-3.
6. Remove screws which fasten handles to both side frames of box. Release display panel unit. See figure 4-3.
7. Remove upper panel plate and lower panel plate from display panel unit.
8. Lay display panel so that the panel PC board is face down. Remove screws and washers holding board and remove board. At this time, take care not to let keypads fall free. Observe keypads. They must be in correct positions, in openings in mounting plate, when attaching a board.
9. Fasten new panel PC board temporarily to check alignment of board with display windows. After attaching the new board to the mounting plate, check the keypads mechanically by touch and sound to be sure switches are being operated properly.
10. After confirming proper alignment, fasten panel PC board firmly.
11. Fasten upper and lower panel plates to panel unit and then attach panel unit to control box together with both side handles.
12. Fasten upper and lower panel plates to control box.
13. Install control box from top of power chassis. CN1 connector should go over control PC board.
14. Pull control box toward the front and fasten it with two screws. See figure 4-2.
15. Connect CN1 connector to control PC board.
16. Attach control box cover. See figure 4-1.

Note: Take care to avoid scratching display panel. Panel overlay is made of plastic film.

4-5-2 Replacement of Control P.C. Board.

Tools required: (+) screwdriver.

1. Remove two screws which fasten control box cover. See figure 4-1.
2. Disconnect connectors CN1, CN2, CN4, CN5, CN6, CN7, CN8, CN9, CN10, CN11, CN12, CN13, on control PC board and connector of battery PC board.
3. Disconnect +5 V power supply leads from terminals on DC power supply.
4. Remove four cross head screws holding power chassis box cover and slide the cover back 5 mm. See figure 4-7.
5. Check all connectors to be sure they are identified. If a connector does not bear a reference designation (CN-), mark it and its location on board for identification at reassembly. Disconnect all connectors.
6. Disconnect all connectors.

CAUTION

Never pull connector wires. Grasp connectors body only.

   a. CN1 and CN2 are latched to their mating connectors. Pull latches outward to loosen connectors.
   b. Pry open plastic clips securing CN6, CN7, CN8, CN9, CN10. See figure 4-4.
   c. On small connectors, e.g. CN4, use small screwdriver to pry open plastic reed latches.

7. Remove seven screws and washers which hold control PC board in place. See figure 4-7. Lift board from mounting studs.
8. Fasten new control PC board in place.

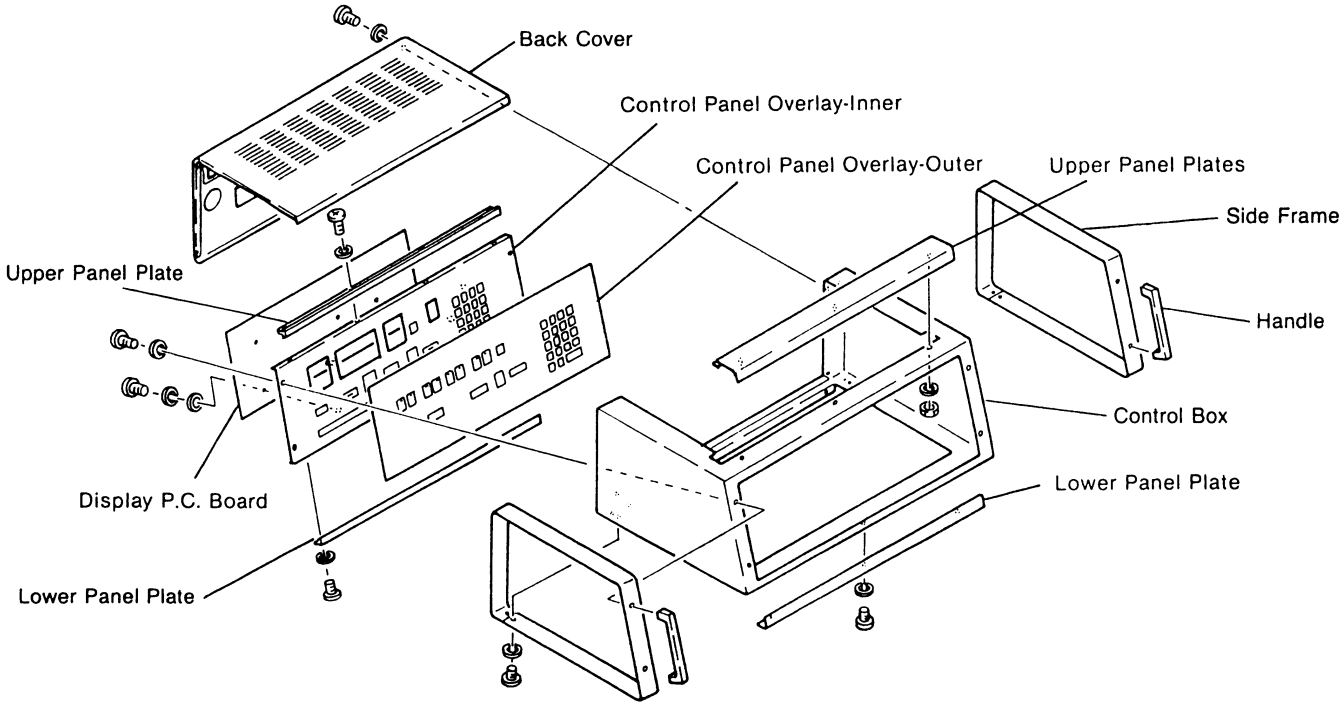


Figure 4-3. Control Panel Assembly

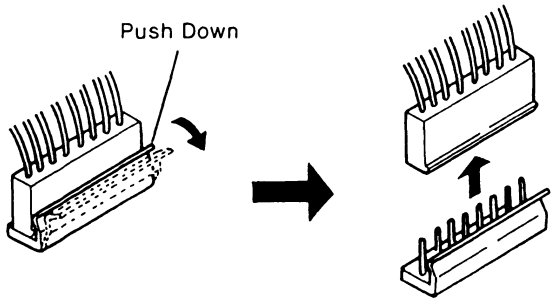


Figure 4-4. Releasing Connectors

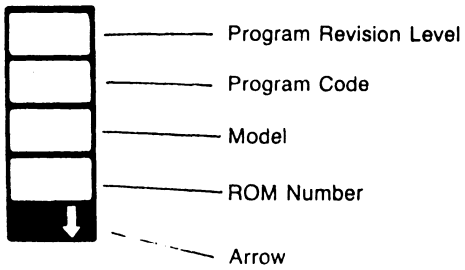


Figure 4-6. EPROM

9. Remove three EPROMs from old board, and install them on new board. See paragraph 3-8-9.
10. Connect connectors CN1, CN2, CN4, CN5, CN6, CN7, CN8, CN9, CN10, CN11, CN12, CN13, and connector of battery PC board. Make sure that CN8 and CN9 connectors are not cross-connected.
11. After assembling control box, perform automatic operation to verify the functions.
12. Key correct time into instrument.

Note: Be sure not to leave dust on the board.

Take care to prevent connectors from being damaged during release, and confirm that all connectors are inserted securely.

Care should be taken to verify the direction, location, and number of each EPROM during installation.

4-5-3 EPROM Replacement.

Tools required: (+) screwdriver.

1. Power off the instrument.
2. Remove control box cover. See figure 4-1.
3. Lift lever of I.C. socket on control board to release EPROM. Lift EPROM from socket. See figure 4-5.
4. Refer to figure 4-6 and observe the following:
   a. ROM 1, 2, and 3 postions are identified by silk screening on board.
   b. ROM's are identified by ROM numbers.
   c. Arrow on ROM must point toward front of processor.

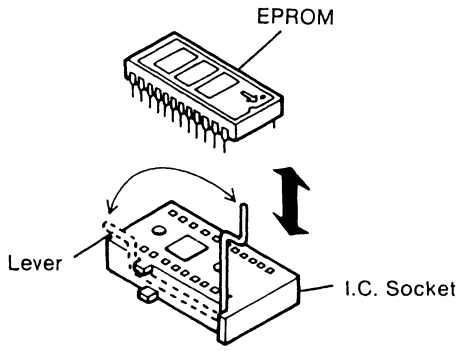


Figure 4-5. Releasing EPROM From Socket

5. Insert EPROM in socket, and push lever downward.
6. If program control number has been changed, confirm display. See manual operation 99, table 3-2.

CAUTION

Be sure to verify direction and postion of EPROMs. If direction is wrong, the EPROMs will be destroyed when power is switched on.

7. Attach control box cover.
8. Power on the instrument.
9. Key correct time into the instrument.

4-5-4 Interlock Sensor Replacement.

The interlock sensor circuitry is mounted on a small PC board. Replace the entire board.

To replace the interlock sensor:

1. Remove the left side panel.
2. Disconnect connection to CN4 on the control board and cut cable ties as necessary to remove cable carefully.
3. Remove two screws which attach PC board to instrument frame and lift out PC board assembly.
4. When installing a new interlock sensor assembly, follow the original cable routing. Tie cable to plastic blocks.

4-6 POWER SUPPLY REPLACEMENT

To replace the power supply:

1. Remove control enclosure as instructed in paragraph 4-5.
2. Disconnect control board as instructed in paragraph 4-5-2.
3. Remove four each screws, washers, and lockwashers which attach control board platform to control chassis.
4. Disconnect power supply leads.
5. Remove two screws A, figure 4-7 at front of chassis and lift out power supply.

NOTE: Access to power transformer and noise filters is obtained by performing steps 1 through 3, above. See figure 4-7.

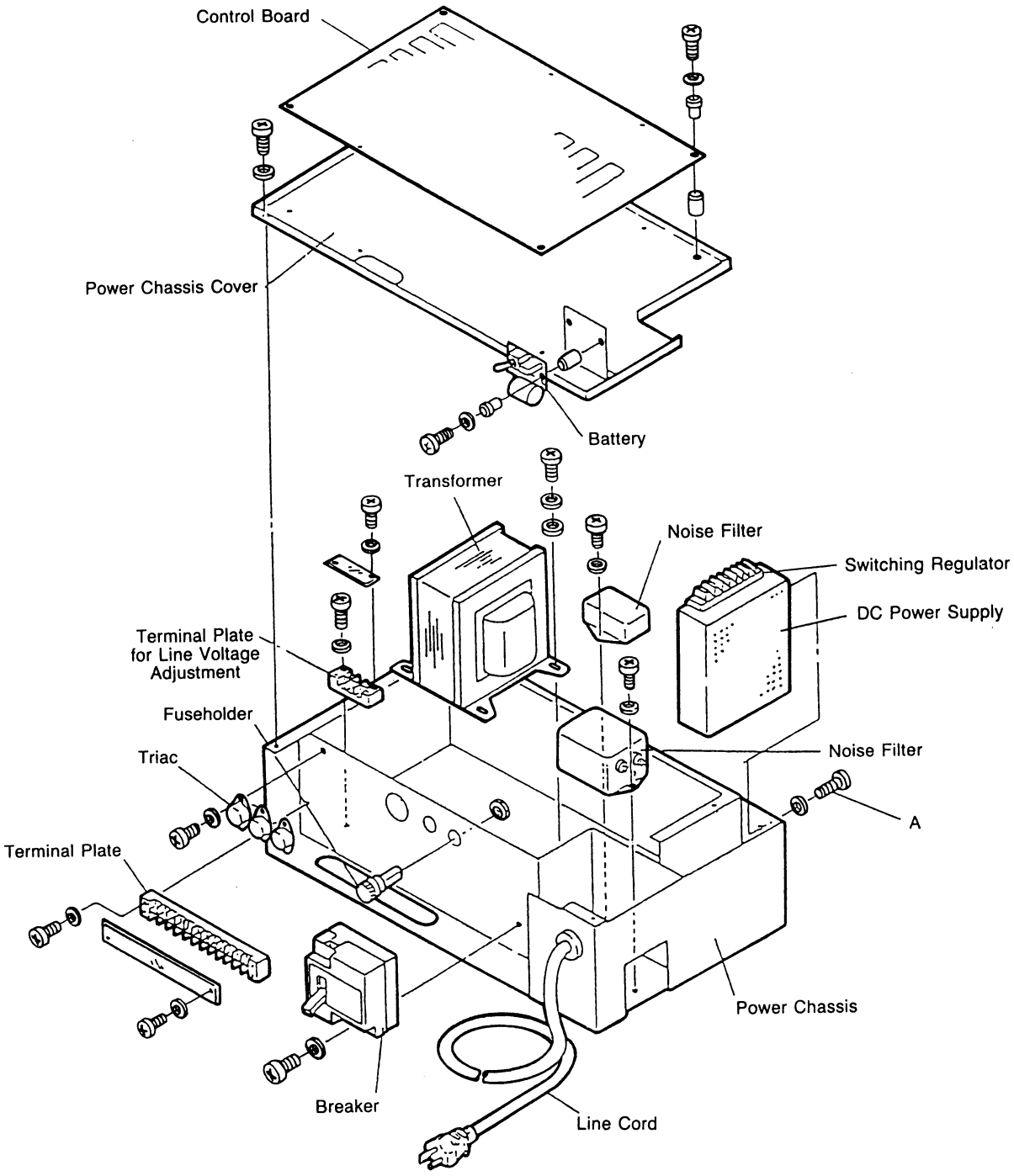


Figure 4-7. Removal of Power Supply and Transformer

4-7 RETORT

NOTE: When servicing a vertical (floor) model, steps 4 and 5 below need not be performed. Remove right side panel from processor.

4-7-1 Removal and Disassembly of Retort.

Tools required: (+) screwdriver, double open-end spanner 14x17 and 5/8x2/4, Ratchet handle No. 349 9.5mm, torque driver 50LTDH, extension bar No. 359 9.5mm, plus bit No. 86, spare socket No. 310 10 mm 9.5mm, cutter knife, box driver 7mm.

Preliminary: Remove left side panel and rear panel of processor. See figure 3-1. Remove control box cover and disconnect CN12 from control board.

To remove retort:

1. Remove retort lid as shown in figure 4-8.
2. Pull out spill tray from beneath oven, and remove hex head bolts at rear of spill tray opening.
3. Remove hex head bolts at rear of retort as shown in figure 4-8.
4. Remove three screws from left center brace of frame (rear view) as indicated in figure 4-8.

CAUTION

When separating halves of instrument, take care not to rupture tubing. Aslo, left half of instrument weighs approximately 150 pounds. Take care to support adequately.

5. Separate right and left halves of processor. See figure 4-8.
6. Remove interlock slide.

NOTE: The two screws attaching slide are accessible through two holes above oven enclosure. See figure 4-8.

a. Slide interlock slide to closed position.
b. Loosen, do not remove, the two screws, and pull slide forward.

7. Loosen, do not remove, six screws which fasten panel under control chassis. See figure 4-8.
8. Remove both side frames of retort as shown in figure 4-8, and pull retort brace toward front of instrument.
9. Remove hex nut for stainless steel union in air path at left side (front view) of retort. See figure 4-8.
10. Loosen the stainless steel union at bottom of retort and pull out Teflon tubes. See figure 4-8.
11. Disconnect wires from terminal block at left side (front view) of retort.
12. Remove retort interlock sensor P.C. board. See paragraph 4-5-4.
13. Remove round gasket at top of oven.
14. Remove four retort mounting screws (right and left). See figure
15. Pull retort assembly toward front of instrument and lift it out. See figure 4-8.
16. Remove four retort-to-assembly mounting screws (front and rear) and remove retort.
17. Remove retort insulation (glass wool).

4-7-2 Replacement of Retort Heater.

NOTE: Test resistance of heaters to determine need for replacement before removing any heaters. Heater resistance should be:
120 ohms (115 Volt model)
480 ohms (240 Volt model)

Tools required: (+) screwdriver, double open-end spanner 14x17 and 5/8x2/4, Ratchet handle No. 349 9.5 mm, torque driver 50LTDH, extension bar No. 359 9.5 mm, plus bit No. 86, spare socket No. 310 10 mm 9.5 mm, cutter knife, box driver 7 mm.

1. Remove retort. See 4-7-1.
2. Detach heater from retort. Cut RTV silicone adhesive with a knife. Scrape residual RTV from retort; then clean retort surfaces with a cloth moistened with thinner.
3. Clean adhering surface of new heater with thinner; then apply silicone RTV to surface.
4. Place heater in position and flatten into place with a squeegee or roller. There shall be no wrinkles ir the heater, nor air bubbles in the RTV. Positions of heaters are indicated in figure 4-8. Allow 24 hours cure time for RTV.
5. Connect solderless terminal to leads of new heater and then connect leads of heater to terminal plate.
6. Attach retort. See 4-7-6.

4-7-3 Replacement of Retort Thermistor.

Tools required: (+) screwdriver, double open-end spanner 14x17 and 5/8x2/4, Ratchet handle No. 349 9.5 mm, torque dirver 50LTDH, extension bar No. 359 9.5 n plus bit No. 86, spare socket No. 310 10 mm 9.5 mm, cutter knife.

1. Remove retort. See paragraph 4-7-1.
2. Remove thermistor from retort heater. See figure 4-9. Cut silicone adhesive, if necessary.
3. Remove residual silicone adhesive from retort heater, and then clean surface with a cloth moistened with thinner. Take care not to damage surface of heater.

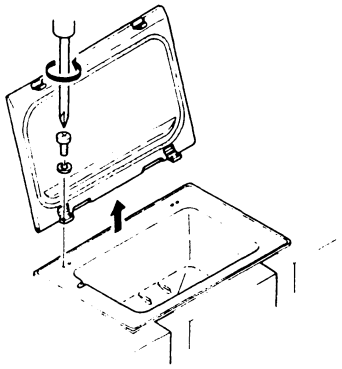
NOTE: The sensor of the thermistor shall contact the surface of the retort. Do not allow RTV between contact surfaces.

4. Attach new thermistor with connector in same postion with same volume of silicone adhesive as before. Fasten rubber over thermistor and push. See figure 4-10.
5. Dry the thermistor with a dryer for 2 to 3 minutes to ensure fastening.
6. Reinstall retort. See 4-7-6.

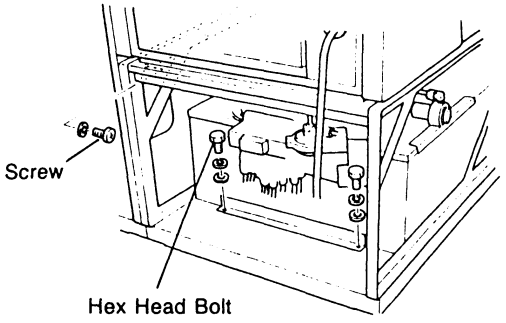
4-7-4 Replacement of Retort Resettable Thermal Cutout.

Tools required: (+) screwdriver, radio pliers.

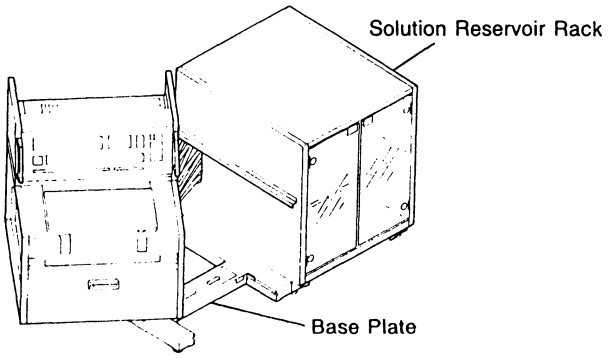
1. Remove the left panel behind the retort.
2. Disconnect slip-on connections from thermal cutout figure 4-9.



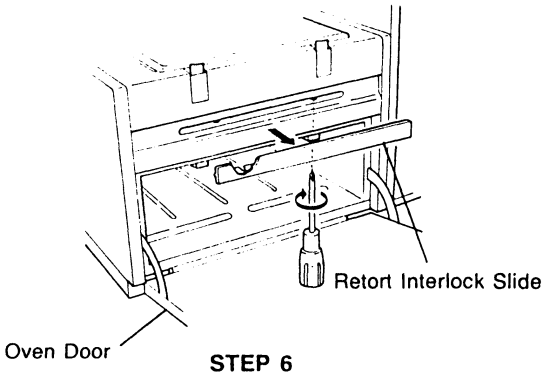
STEP 1



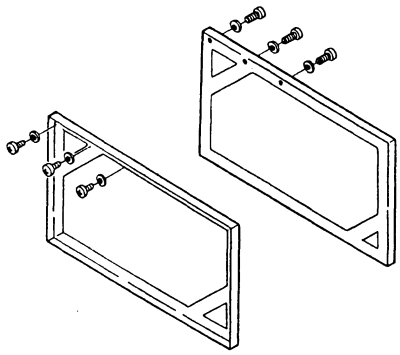
STEPS 3 & 4



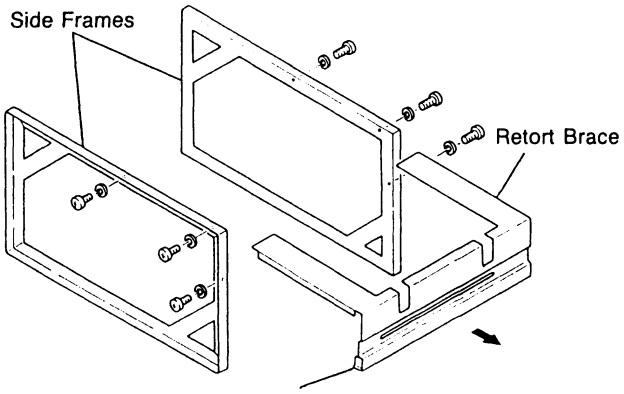
STEP 5



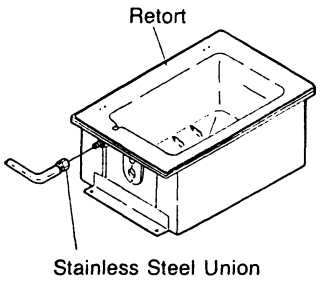
STEP 6



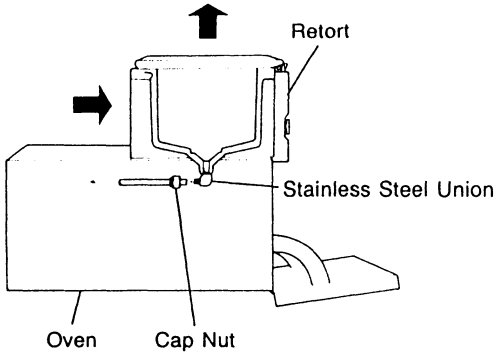
STEP 7



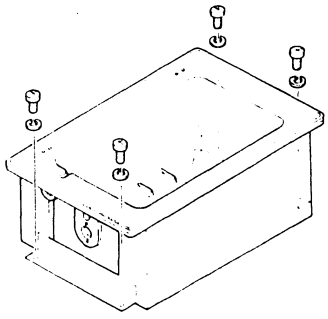
STEP 8



STEP 9



STEPS 10,15



STEP 14

Figure 4-8. Retort Replacement

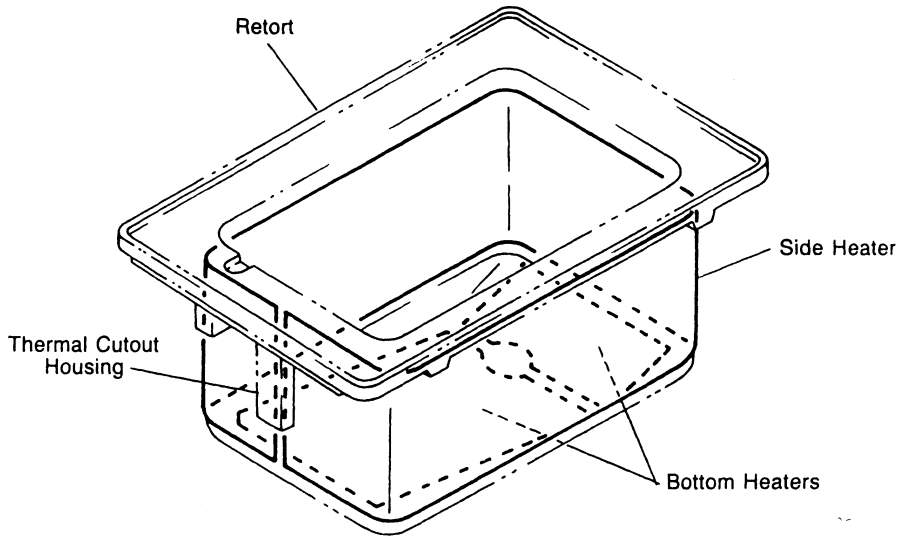


Figure 4-9. Replacement of Retort Heaters

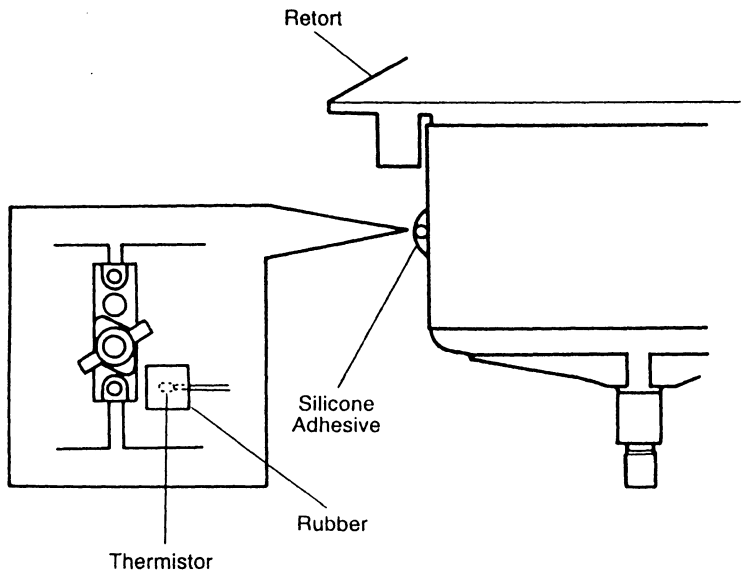


Figure 4-10. Retort Thermistor Replacement

3. Remove two screws which attach cutout, and pull cutout from mounting hole. Clean residual RTV silicone adhesive from hole.
4. Apply silicone RTV to end of new cutout, insert it into mounting hole, and fasten it in place with screws removed in step 3, above.
5. Reattach slip-on connectors.
6. Reinstall left panel.

4-7-5 Replacement of Retort Fusible Thermal Cutout.

Tools required: (+) screwdriver, cutter knife, hand press, (-) screwdriver.

1. Remove the left panel behind the retort. See figure 2-1.
2. Cut leads of thermal cutout with diagonal cutter.
3. Cut RTV silicone adhesive away from thermal cutout, and pull cutout from mounting hole. Clean residual RTV from hole. See figure 4-11.

CAUTION

The cutout shall make direct contact with the retort wall.

4. Coat surface of thermal cutout with silicone RTV, and insert cutout into hole in retort. The end of the cutout should be flush with the surface of the retort. Cure time for silicone adhesive is 24 hours.
5. Connect leads to new thermal cutout with solderless terminal.

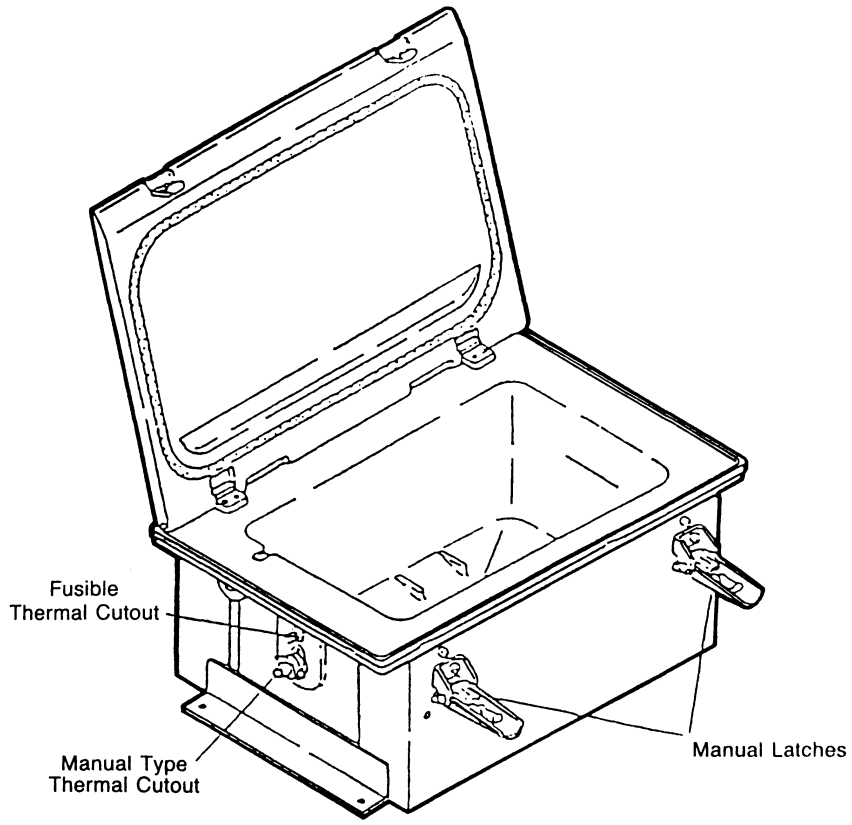


Figure 4-11. Replacement of Fusible Thermal Cutout

Splice cutout leads to leads remaining in retort as follows:

a. Strip all 4 leads about 1/4 inch.
b. Place a piece of heat-shrinkable tubing long enough to overlay both ends of crimp splice about 1/4 inch over leads of thermal cutout.
c. Splice leads with crimp splices.
d. Move heat shrinkable tubing over each splice, taking care to overlap both ends of splice. Apply heat to shrink the tubing.

6. Reinstall left panel.

4-7-6 Assembly of Retort.

To assemble retort:

1. Check that three heaters, two thermal cutouts and thermistor are properly installed.
2. Bundle all loose wire ends for passage through access hole.
3. Wind glass wool around retort. Fasten in place with aluminum tape.
4. Insert retort into its case, taking care not to crease glass wool. Fasten retort into place at front and rear with four stainless steel screws. Torque screws at front to 29 kg cm.
5. Set retort on instrument frame and push it slightly toward the rear. See figure 4-8. Check that Teflon pipe is inserted into stainless steel union under retort.
6. Fasten retort with four screws at right and left ends. See Figures 4-8 and 4-12.

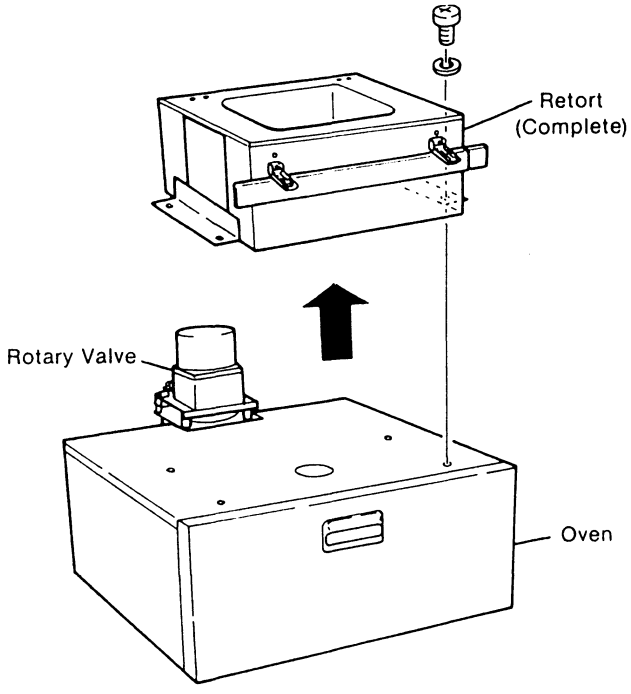


Figure 4-12. Retort Replacement

7. Connect leads of thermal cutouts and heater to terminal block.
8. Connect air line to left side of retort with a stainless steel union. See figure 4-8.
9. Reinsert retort brace and fasten it with six screws after aligning both side frames under control box. See figure 4-8.
10. Attach sides frames. See figure 4-8.
11. Reattach retort interlock bar. See figure 4-8.
12. Attach round gasket to top of oven with silicone RTV.
13. Connect Teflon pipe to stainless steel union with cap nut at the bottom of the retort (inside the oven).
14. (Counter-top model only) Refasten left half of processor to right half.
    a. Align sections.
    b. Insert and tighten hex head bolts below rotary valve and at left under oven. See figure 4-8. 15. Reattach interlock detector P.C.board.
16. Connect CN12 to its position on the control PC board and reattach control board cover.
17. Reattach retort lid. See figure 4-8. 18. Reattach left side and rear panels. See figure 2-1.

4-7-7 Retort Cover Gasket Replacement.

To replace the retort cover gasket:

CAUTION

Do not use tools.

1. Compress bottom of gasket with fingers to start it from groove. Pull gasket from groove.
2. Clean the groove with a cloth moistened with xylene.
3. Install a new gasket as shown in figure 4-13. Press into place with fingers as necessary.
4. Perform manual pressurization of retort to check for air leads. Adjust gasket as necessary.

Note: Take care not to damage the gasket during installation.

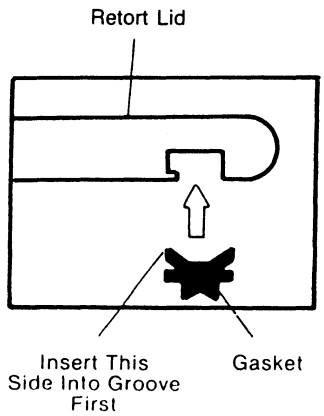


Figure 4-13. Retort Lid Gasket Replacement

4-7-8 Retort Manual Latch Replacement

Tools required: (+) screwdriver, radio pliers, torque driver 50LHDH, plus bit No. 86.

1. Slide interlock slide to left.
2. Remove two screws which fasten latch in place. See figures 4-11 and 4-14.
3. Attach new latch with same stainless steel screws with torque of 14 kgcm.
4. Adjust latch by turning latch hook clockwise in its threaded yoke in order for retort lid to provide adequate sealing when closed. See figure 4-15.
5. Perform manual pressurization of retort to check for air leaks.

Note: Take care not to over-tighten the retort lid with retort latch.

Do not use any screws other than the specific screws for retort latch.

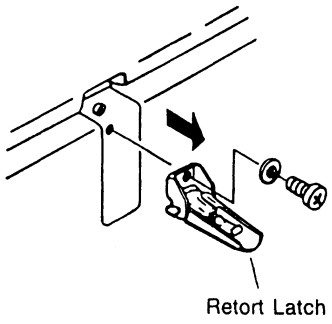


Figure 4-14. Manual Latch Replacement

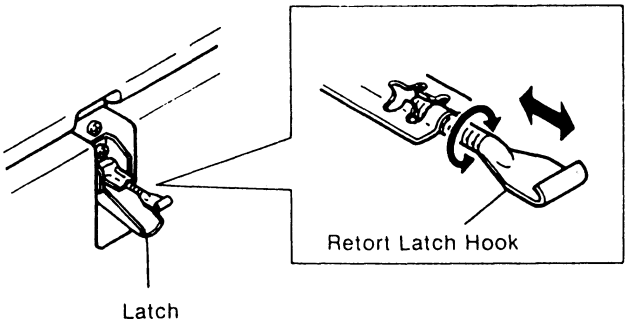


Figure 4-15. Retort Cover Latch

4-8 PARAFFIN OVEN

4-8-1 Removal and Disassembly of Paraffin Oven.

Tools required: (+) screwdriver, double open-end spanner 14x17 and 5/8x2/4, Ratchet handle No. 349 9.5 mm, torque driver 50LTDH, extension bar No. 359 9.5 mm. plus bit No. 310 10 mm 9.5 mm, cutter knife, tester.

To disassemble paraffin oven:

1. Remove retort as instructed in paragraph 4-7-1.
2. Remove control box cover and disconnect connectors CN2, CN4, CN6, CN7, CN9, CN11, CN12, CN13, and pull out interconnecting cables from underside of control box.
3. Remove all stainless steel hex capnuts from rotary valve ports to facilitate oven removal. See figure 4-16.
4. Remove screws from vertical frame members which support side panels and separate control box and frame members from oven unit.
5. Remove bolts which attach door hinge to oven, then guide oven door stop arms through square holes. Remove door.
6. Remove six screws which fasten joint pipe plate inside of oven. Open stainless steel union for connections to stations 11 and 13 (at ends of joint pipe plate) and remove tubing. See figure 4-17.

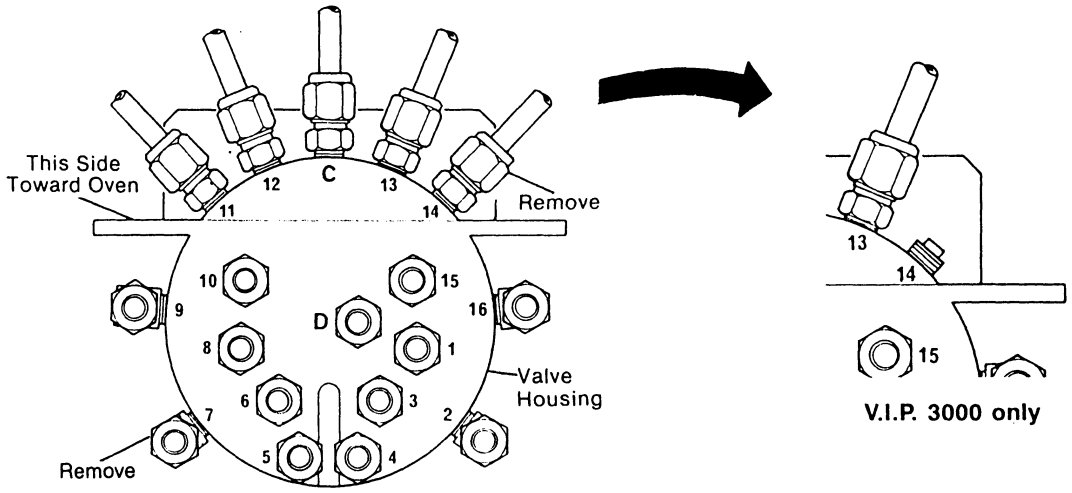


Figure 4-16. Underside of Rotary Valve

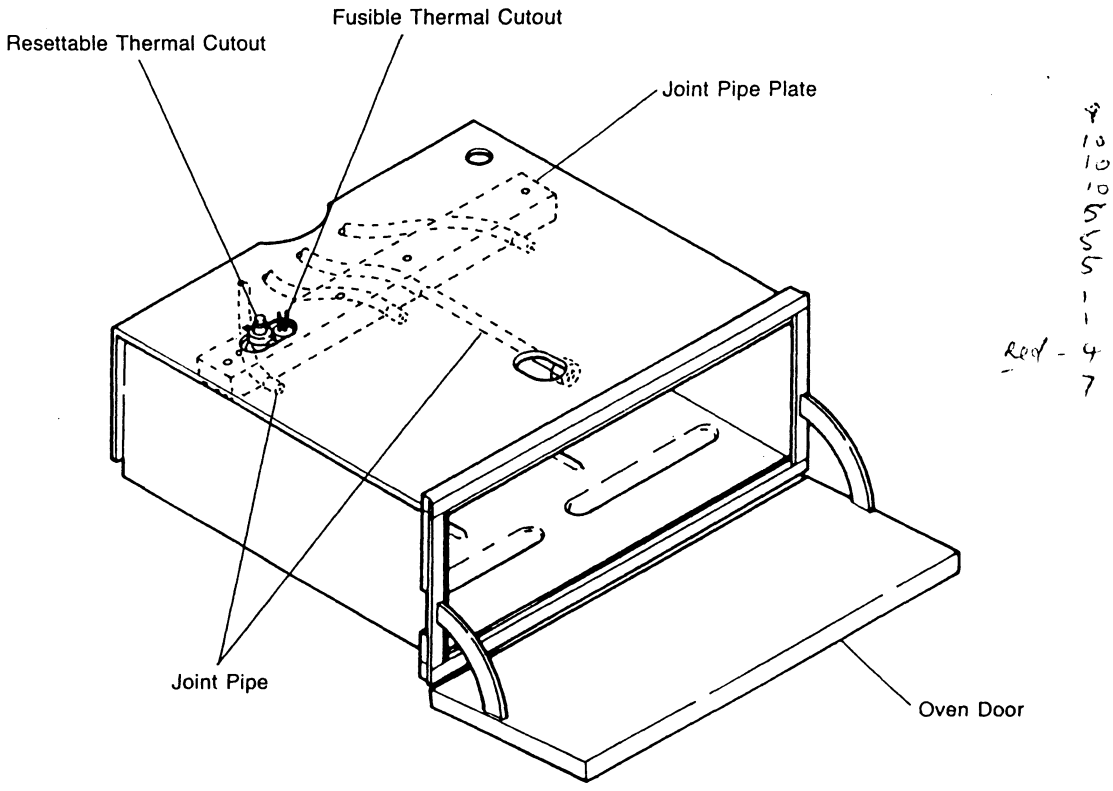


Figure 4-17. Thermal Cutouts in Oven

7. Remove two screws which attach oven to rotary valve from inside rear wall of oven.
8. Disconnect rotary valve heater leads from terminal block at rear of oven.
9. Disconnect control box leads and rotary valve PC board leads from terminal block on rotary valve.
10. Release rotary valve from oven by removing two screws which attach valve to the outside rear of oven. Then press down on stainless steel pipe, figure 4-16, to allow removal of valve. Remove rotary valve.
11. Remove Teflon tubing which connects overflow trap to air system. See figure 2-2.
12. Disconnect overflow heater leads from terminal block at the rear of oven. Remove overflow tube from oven.
13. Remove exterior top panel and insulating material from oven.
14. Lift oven from processor.

4-8-2 Replacement of Oven Heater.

Note: Disconnect and check resistance of oven heaters to determine need for replacement. Resistance of oven heater should be 120 ohms (115 V model) 480 ohms (240 V model) There are four heaters in the oven; one at the top, three at the bottom. To replace oven heater:

1. Disconnect heater leads from terminal block at rear of oven. Remove inside bottom panel of oven.
2. Remove heater from oven. Remove residual RTV silicone adhesive with a cloth moistened with thinner.
3. Clean one side of new heater with a cloth moistened with RTV thinner.
4. Apply a coating of silicone RTV to the cleaned side of the heater and lay heater in place in the oven. See figure 4-18.
5. Press heater down firmly with a small squeege or roller. Eliminate wrinkles and/or air bubt Remove excess RTV which may ooze out around edges of heater. Allow 24 hours cure time for RTV.

4-8-3 Replacement of Oven Thermistor.

Tools required: (+) screwdriver, double open-end spanner 14x17 and 5/8x2/4, Ratchet handle No. 349 9.5 mm, torque driver 50LTDH, extension bar No. 359 9.5 mm, plus bit No. 86, spare socket No. 310 10 mm 9.5 mm. cutter knife, tester.

To replace an oven thermistor:

1. Remove inside bottom panel of oven.
2. Cut tape (or cable tie) which bands thermistor leads to heater leads.
3. Remove thermistor from underside of oven, and clean residual RTV from thermistor groove with knife; then clean groove with RTV thinner.

Note: When installing new thermistor the sensor must contact oven. Do not allow RTV between oven and thermistor sensor.

4. Attach new thermistor with silicone RTV as shown in figure 4-19. Allow 24 hours cure time for RTV.
5. Band thermistor leads to heater leads with tape or cable tie (whichever was used originally).

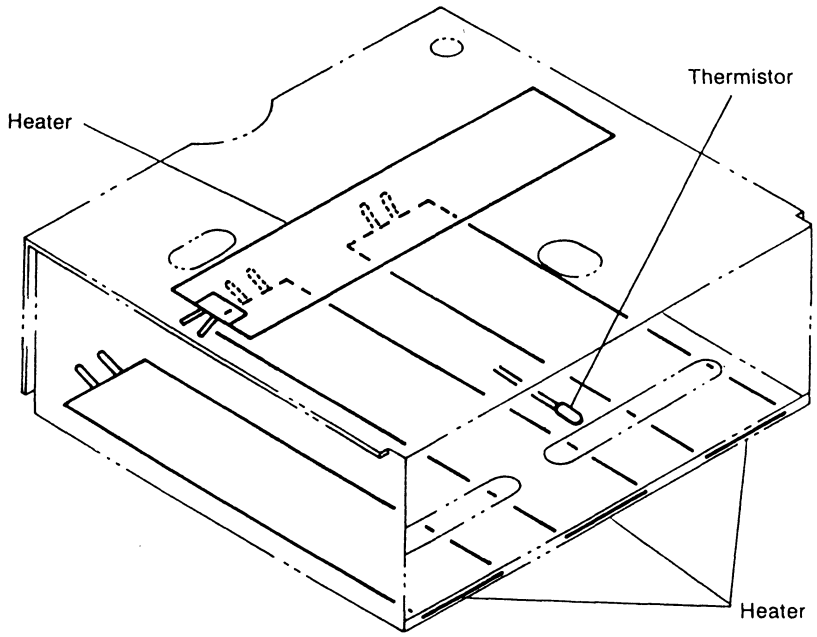


Figure 4-18. Oven Heater Replacement

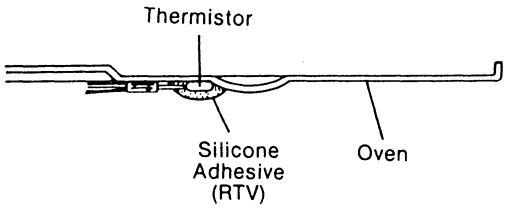


Figure 4-19. Replacement of Oven Thermistor

4-8-4 Replacement of Fusible Thermal Cutout. (See figure 4-17.)

Tools required: (+) screwdriver, cutter knife, hand press, (-) screwdriver pliers.

1. Remove left panel and rear panel behind oven. See figure 2-1.
2. Remove cutout from oven. Remove all residual RTV silicone adhesive.
3. Connect leads to new thermal cutout with solderless terminal.
4. Cut thermal cutout leads.
5. Splice leads of new cutout to leads remaining in oven as follows:
   a. Strip all four leads about 1/4 inch.
   b. Place a piece of heat shrinkable tubing, long enough to overlap both ends of a crimp splice about 1/4 inch, over leads of new thermal cutout.
   c. Splice leads with crimp splices.
   d. Move heat shrinkable tubing over each splice, taking care to overlap both ends of splice. Apply heat to shrink the tubing.

CAUTION

Cutout shall make direct surface contact with oven wall.

6. Attach thermal cutout to oven with silicone RTV. Allow 24 hours cure time.

Note: Outer end of cutout should be flush with oven wall.

4-8-5 Replacement of Resettable Thermal Cutout in Oven. (See figure 4-17.)

Tools required: (+) screwdriver, radio pliers.

1. Remove left panel and rear panel behind oven. See figure 3-2.
2. Disconnect slip-on connectors from cutout.
3. Remove two screws which attach cutout, and remove cutout. Clean residual RTV from mounting area.
4. Apply silicone RTV to sensor of new cutout and attach cutout to oven with two screws removed in previous step.
5. Reconnect slip-on connectors to cutout.

4-8-6 Assembly of Oven

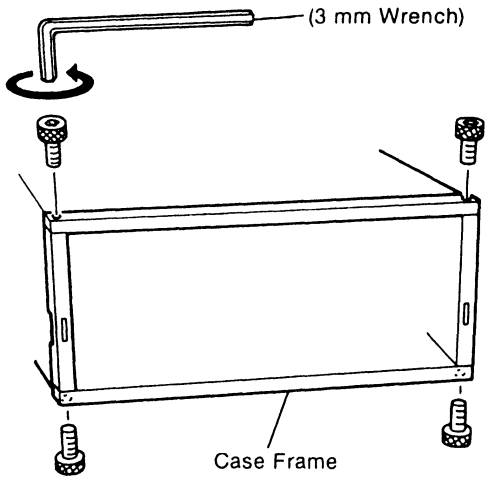
1. Wind insulating material around oven and reattach inside top and bottom panels of oven.
2. Install overflow tube.
3. Reattach aspirator system.
4. Install rotary valve unit and connect Teflon tubing.
5. Reattach oven door.
6. Install retort unit. See paragraph 4-7-6.
7. Attach control box.
8. Fasten outer panels.

4-8-7 Replacement of Oven Door Seal. (See figure 4-20.)

Tools required: (+) screwdriver, hexagon wrench 3 mm.

To replace an oven door seal:

1. Remove oven from processor as instructed in paragraph 4-8-1. Disconnect heater leads from terminal block at rear of oven.



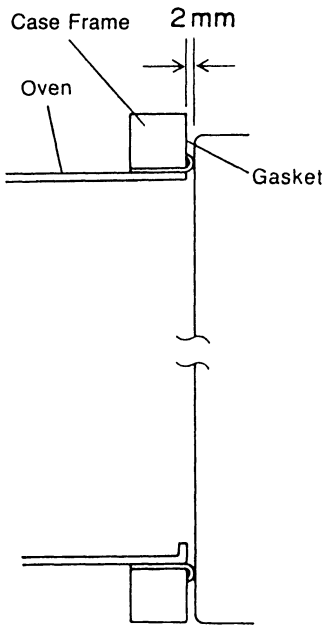


Figure 4-20. Oven Door Seal Replacement

2. Remove top panel of oven.
3. Peel off four number decals (11, 12, 13, 14) inside of oven. Note postion of each number carefully.
4. Remove two magnetic latches from oven.
5. Remove eight flat-head screws from top and bottom inside oven.
6. Disassemble case frame by removing four socket-head screws.
7. Remove door seal.
8. Insert new door seal into interior of oven and install upper and lower case frames. Seal should protrude from oven interior about 2mm.

Note: A new door seal does not have holes to pass screws. Pierce seal at screwholes with points of flat-head screws.

9. Align verticle case frames with horizontal case frames. Reassemble frames.
10. Affix four new number decals to conceal screws. Wipe surface of new seal with a cloth moistened with xylene.
11. Install oven as instructed in paragraph 4-8-6.

4-8-8 Paraffin Pot O-Ring Replacement (See figure 4-21.)

Tools required: (-) screwdriver, monkey wrench.

To replace O-ring in paraffin pot, unscrew coupling cap. Remove O-ring with screwdriver. Coat new ring with cup grease or petroleum jelly. Insert new ring and fasten coupling cap.

4-8-9 Adjustment of Paraffin Pot Coupling. See figure 4-21.

Tools required: Box driver 8 mm.

To adjust paraffin pot coupling:
1. Loosen adjusting nut.
2. Place paraffin pot into oven and mate coupling with pipe.
3. Tighten adjusting nut with pipe inserted.

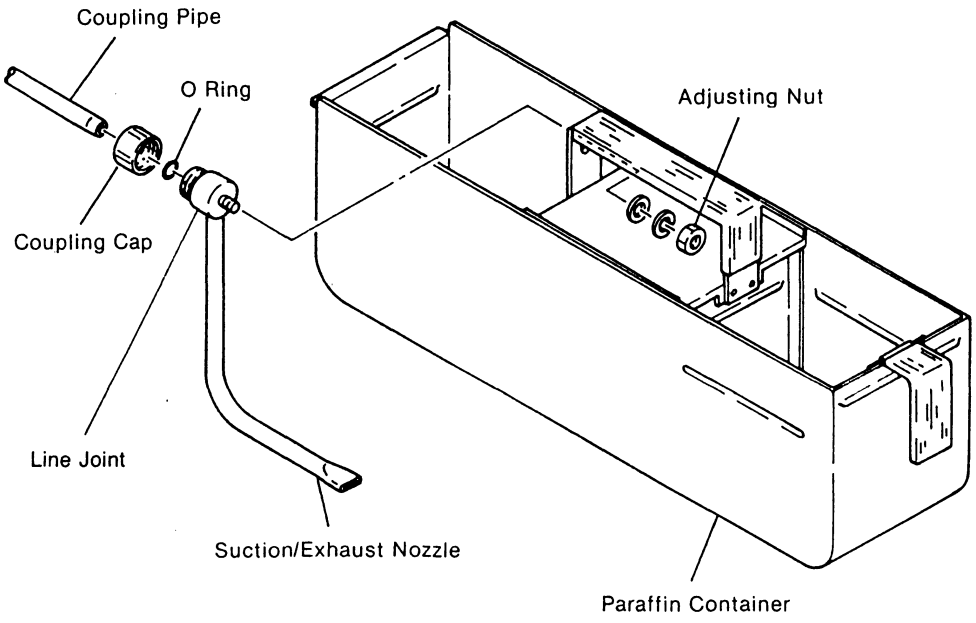


Figure 4-21. Paraffin Pot

4-9 AIR/VACUUM SYSTEM

4-9-1 Tightening of Unions.

Tools required: Double open-end wrench (14x17, 5/8x2/4).

Whenever tightening unions in the air/vacuum system, it is important to observe the instructions which follow in order to prevent air leaks. Two types of unions, plastic and stainless steel, are used. Two sizes are used - 6 mm and 8 mm.

NOTE: All threaded joints must be cleaned of old sealing tape, and two layers of new tape applied. Tape should start 1-1/2 threads from open end of fitting.

4-9-1-1 Sleeves. Whenever a plastic union has been opened, the sleeve, figure 4-22, should be replaced with a new one.

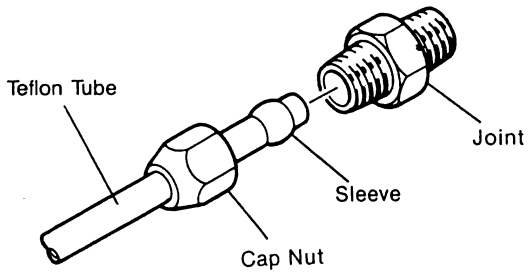


Figure 4-22. Plastic Union

4-9-1-2 Plastic unions, 6mm. Tighten this type of union to the point where screw threads are concealed when capnut meets hex nut.

4-9-1-3 Plastic Union, 8 mm. Tighten this type of union finger tight; then use a wrench to make final 1/2 turn.

4-9-1-4 Stainless Steel Union, Both Sizes. See figure 4-23. A stainless steel insert must be in the end of the Teflon tubing, and a ferrule must be around the end of the tubing before tightening the capnut. Tighten capnut finger tight, then use a wrench to make the final complete turn.

4-9-2 Pump Replacement (See paragraph 2-2-1-1.)

Tools required: (+) screwdriver, double open end-spanner 14x17 and 10x8, hexagon wrench 5 mm, box driver 8mm.

To replace the pump:

1. Remove rear panel behind pump.
2. Open all air connections from pump to manifolds.
3. Loosen, but do not remove, socket head cap screw at right bottom of pump frame (rear view).

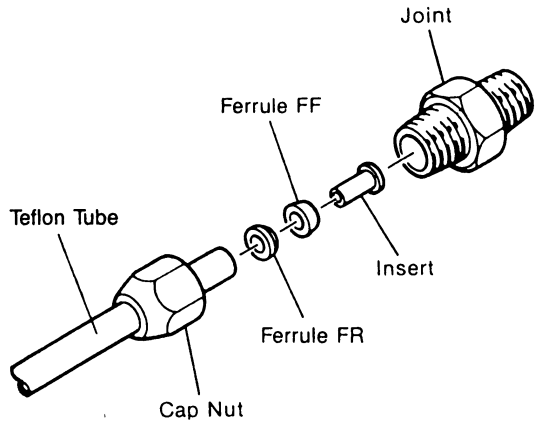


Figure 4-23. Stainless Steel Union

4. Remove the three remaining socket head cap screws which fasten pump frame in place.
5. Disconnect electrical connections to pump.
6. Swing pump frame out from left, pivoting on screw loosened in step (3), above. See figure 2-6.

CAUTION

The pump frame must be supported in pivoted postion.

7. Disconnect air lines from pump at top (both cylinders).
8. Remove four each brass mounting nuts, washers, and lockwashers. Remove pump from anti-vibration mountings.
9. Before installing pump, clean old Teflon tape from all fittings opened in steps 2 and 8, above. Apply new Teflon tape to threads. Tape should be 1-1/2 threads from open end of fitting.
10. Tighten plastic fittings finger tight; then 1/4 turn with wrench.

4-9-3 Pump Repair. (See figure 4-24.)

Tools required: (+) screwdriver, double open-end spanner 14x17 and 10x8, hexagon wrench 5mm.

To disassemble pump (either cylinder):

1. Remove six hex head bolts and washer fastening pump head in place, using an 8 mm wrench. Lift head off.
2. Remove Phillips head screw and washer from center of exposed interior for access to diaphragm.
3. Remove two Phillips head screws from underside of pump head.
4. Remove metal plate, then reed valve. See figure 4-25.
5. When reassembling cylinder, lay diaphragm into place. Align screw holes, and drive three head fastening screws 120° apart partially into sockets to align gasket before tightening center washer. Always use a new Teflon seal under head of screw which fastens washer. When center washer is fastened, remove screws.

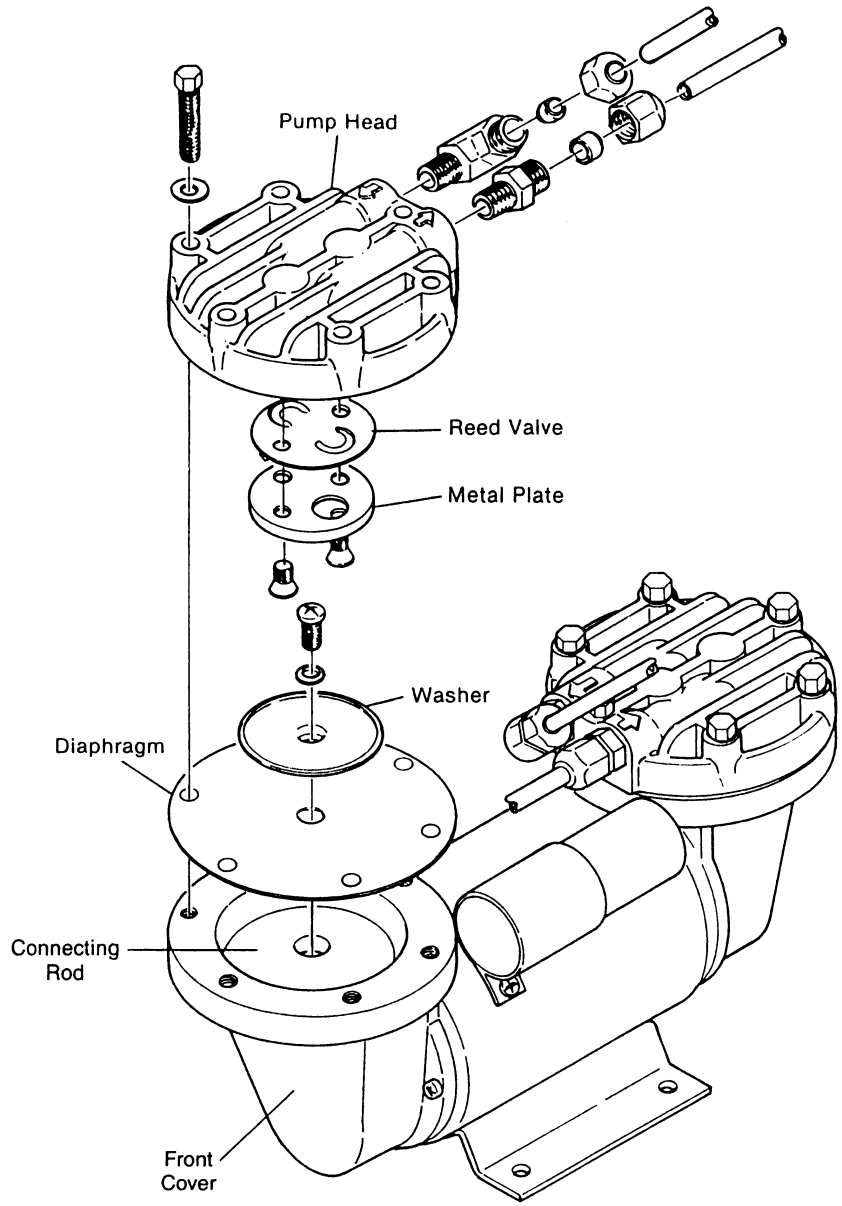


Figure 4-24. Air/Vacuum Pump, Exploded View

To reassemble pump head:

1. Lay reed valve in place. Tab on valve must fit into u-shaped recess in pump head.
2. Lay metal plate in place and fasten with two screws.

To reassemble pump:

1. Lay diaphragm into place.
2. Reassemble cylinder as instructed in step 5, above.
3. Reattach pump head assembly.

4-9-4 Solenoid-operated Valve Replacement.

Tools required: Double open-end spanner 14x17, (+) screwdriver, (−) screwdriver, (+) screwdriver (short), hexagon wrench 5mm.

NOTE: A solenoid-operated valve need not be replaced if cleaning restores it to proper operation. See paragraph 4-9-5.

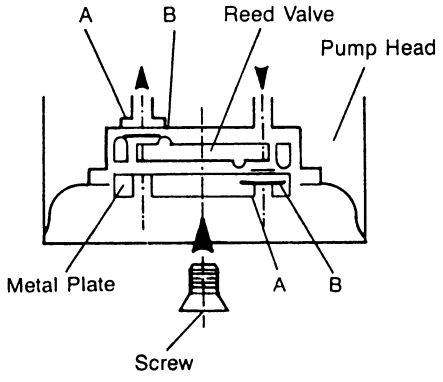


Figure 4-25. Replacing Reed Valve

To replace a solenoid-operated valve:

1. Perform steps 1 through 6 of paragraph 4-9-2.
2. Remove hex cap nut on plastic union at top of valve. Remove the Teflon tube by pulling out. See figure 2-6.
3. Disconnect leads of valve at terminal block.
4. Remove two screws which fasten valve to air/vacuum sytem and lift valve off.
5. Remove plastic union from valve, and clean off old sealing tape. Wind two layers of new tape around threads of union. Tape should start 1 thread in from threaded end.
6. Insert union in new solenoid valve and fasten valve.
7. Reassemble Teflon tube to union, and fasten hex cap nut. See figure 4-22. Reassemble union to valves.
8. Attach solderless terminal to valve leads and connect leads to terminal plate.
9. Attach valve to air/vacuum system with two screws removed in step 4, above.

NOTE: Take care to prevent dust or other foreign materials from entering valve or fittings.

4-9-5 Solenoid-operated Valve Disassembly and Cleaning. (See figure 4-26.)

NOTE: Each of the three solenoid-operated valves has a full-wave bridge rectifier inserted in the two wires leading from the solenoid valve to the terminal block. The rectifier is covered with heat shrinkable tubing. Always use solenoid-operated valves with full wave bridge rectifiers in this instrument.

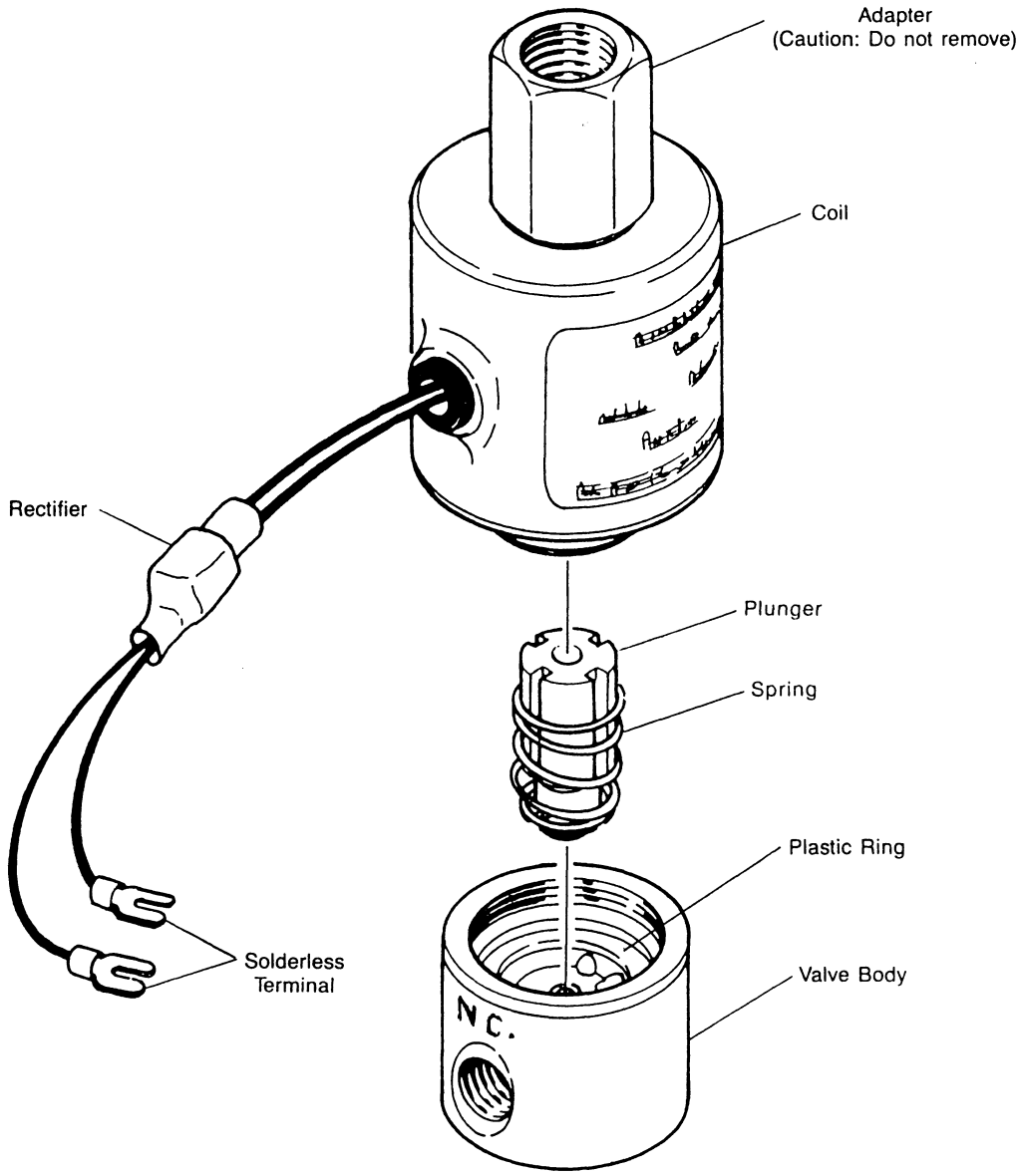


Figure 4-26. Solenoid-Operated Valve

To clean a solenoid valve:

1. Remove valve as instructed in paragraph 4-9-4, above.
2. Hold base of valve. Insert a screwdriver into top of adapter, and turn counterclockwise until base separates from valve body. Plunger and spring will be removable.
3. Clean the following parts with a cloth moistened with xylene:
   Plunger
   Spring
   O-ring
   Inside of Coil/Valve Assembly

4-9-6 Replacement of Pressure Relief Valve or Vacuum Relief Valve.

For replacement techniques see paragraph 2-2-2.

4-9-7 Replacement or Cleaning of Damper Filters.

For access to filter assembly in the damper it is necessary to pivot pump frame outward as instructed in paragraph 4-9-2.

CAUTION

Frame must be supported in its pivoted position.

To replace filter assembly:

1. Disconnect fitting at end of plastic elbow.
2. Remove elbow.
3. Use a crescent wrench to remove filter assembly. If filter assembly is to be cleaned, but not replaced, immerse it in xylene for a few minutes, and allow to dry before reassembling to damper.

4-9-8 Replacement of Air Manifold.

For access to heads of screws holding air manifolds to rear wall of reservoir compartment, it is necessary to remove both end reservoirs; upper for upper manifold, lower for lower manifold.

To replace an air manifold:

1. At manifold, disconnect tubing routed to rotary valve.
2. Disconnect inter-manifold tubing.
3. At each end of manifold, remove supporting screw from rear wall of reservoir compartment.

NOTE: When replacing lower manifold, remove tubing and fittings which connect right and left portions of manifold. Attach them to new manifold.

4-10 ROTARY VALVE

The rotary valve may be considered as consisting of two parts-motor and gearhead assembly, and rotary valve. The complete assembly is shown in figure 4-27.

Tools required: (+) screwdriver, double open-end spanner 7x8, hexagon wrench 2.5 mm, Ratchet handle No. 349, spare socket 8 mm, monkey wrench 250 mm.

To disassemble rotary valve:

1. Remove rear panel of processor behind valve. See figure 2-1.
2. Remove terminal board cover and disconnect power and valve motor leads at terminal board, and disconnect connector from postion sensing PCB, figure 4-27.

NOTE: In following step, lift motor and gearhead assembly into opening in upper compartment floor, then swing outward.

3. Using an 8 mm hex wrench, loosen four captive screws and lift off the motor and gearhead assembly.
4. Remove four valve mounting screws, figure 4-23, and washer and lift the valve assembly from the valve manifold.

4-10-1 Disassembly of Motor and Gearhead Assembly (See figure 4-28).

To disassemble motor and gearhead assembly:

1. Remove four each screws, washer and nuts which attach motor to gearhead and mounting plate. Lift motor off.
2. On underside of mounting plate, loosen two set screws which fasten valve drive to gearhead shaft, and pull disc drive coupling and key, from shaft. Remove gearhead from mounting plate.

4-10-2 Disassembly of Rotary Valve. (See figure 4-29).

CAUTION

Extreme care must be exercised when handling valve rotor and stationary disc. These parts are machined and polished with high precision to operate as a unit. Any surface mars or scratches will degrade performance.

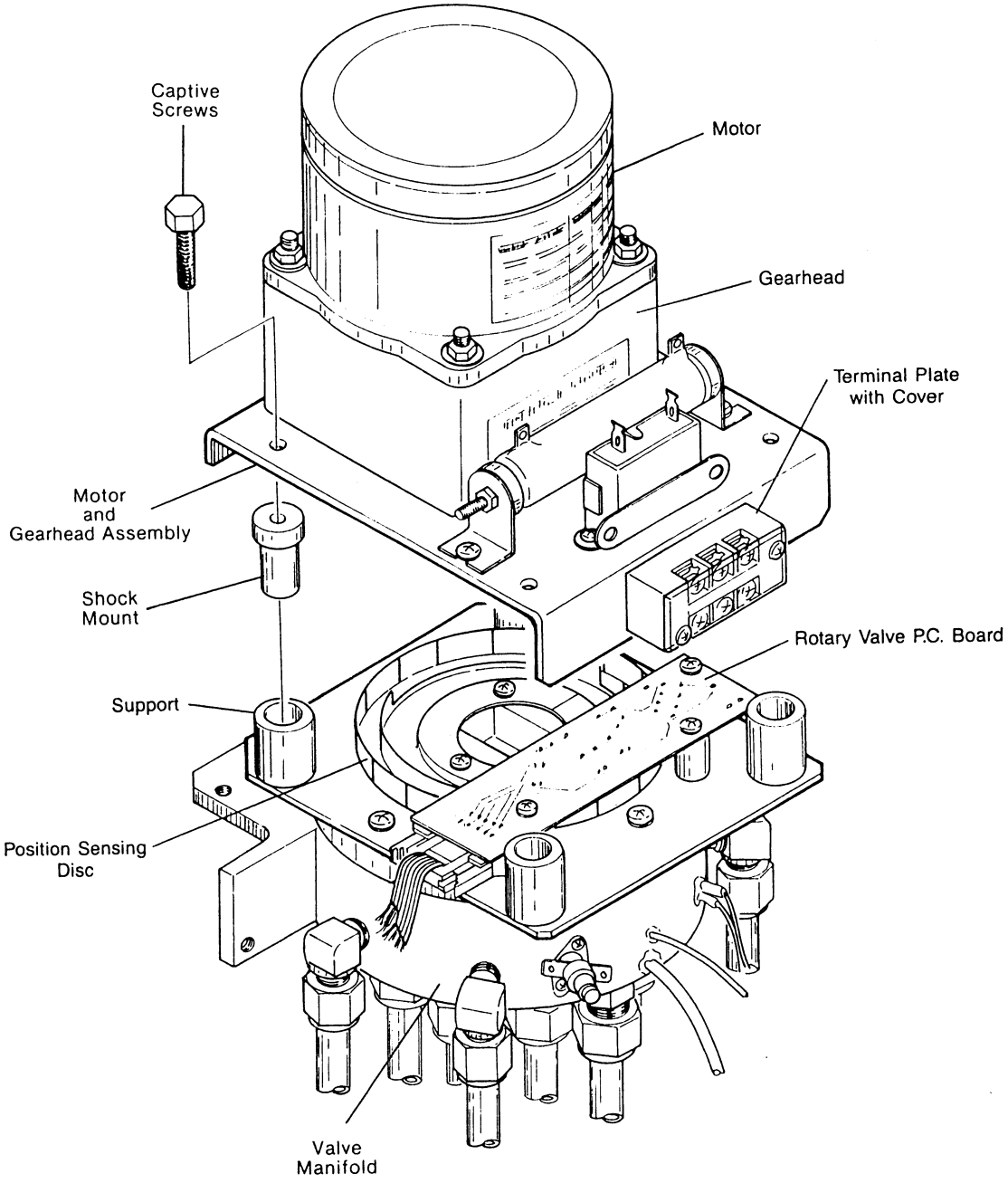


Figure 4-27. Rotary Valve Assembly

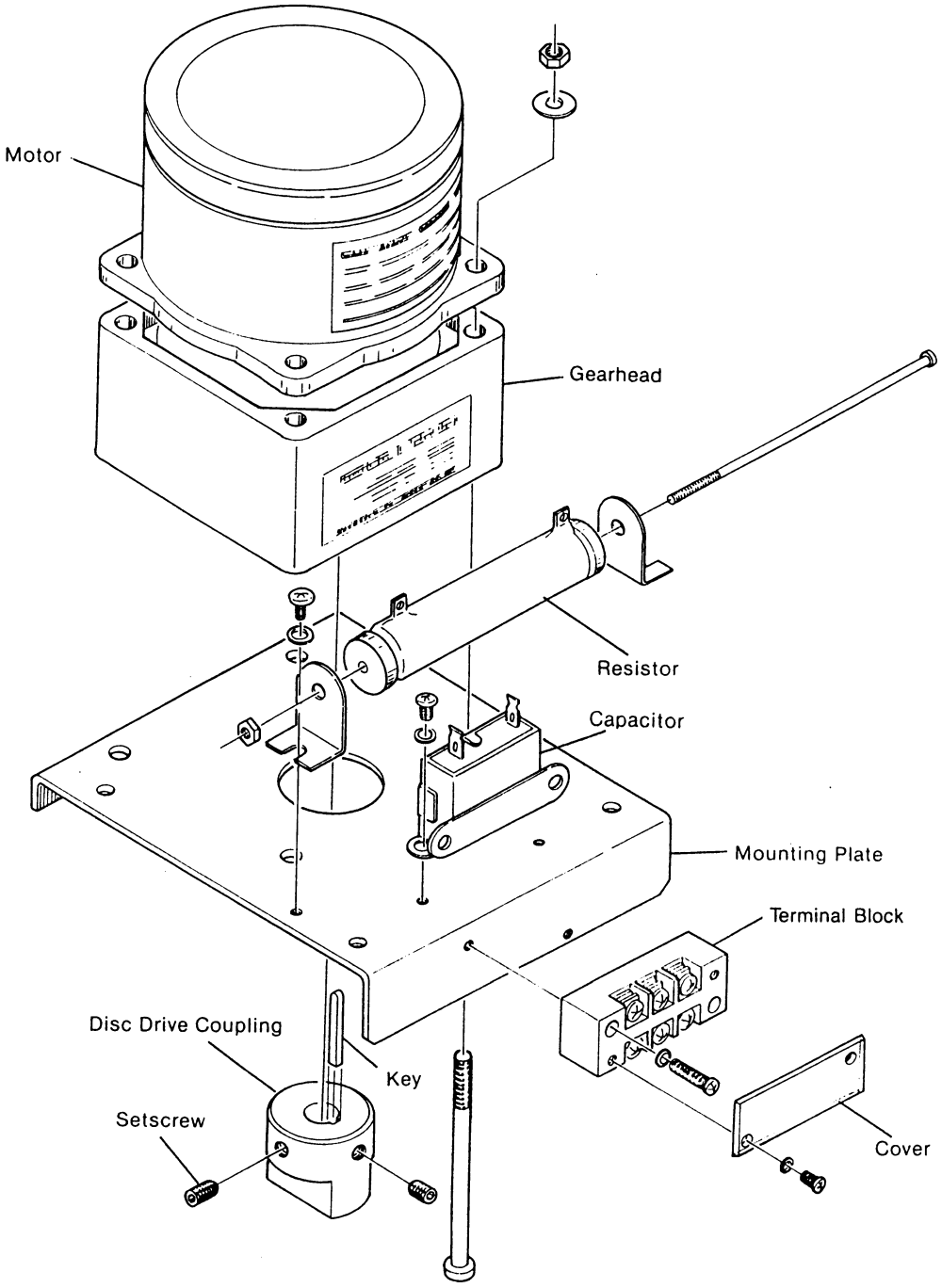


Figure 4-28. Motor and Gearhead Assembly

To disassemble rotary valve:

1. Invert assembly and remove stationary disc with its 17 Kalrez O-rings.
2. Remove Viton V-ring.
3. Turn valve assembly right-side-up and remove three screws which attach postion sensor P.C. board. Remove sensor P.C. board.
4. Remove three screws which fasten positioning ring to valve rotor, and remove positioning ring.
5. Remove valve rotor from underside of mounting plate.
6. Remove mounting ring.
7. Remove parts from top of valve rotor in the following order:
   a. Three wave washers.
   b. Flat washer.
   c. Needle bearing.
   d. Flat washer.

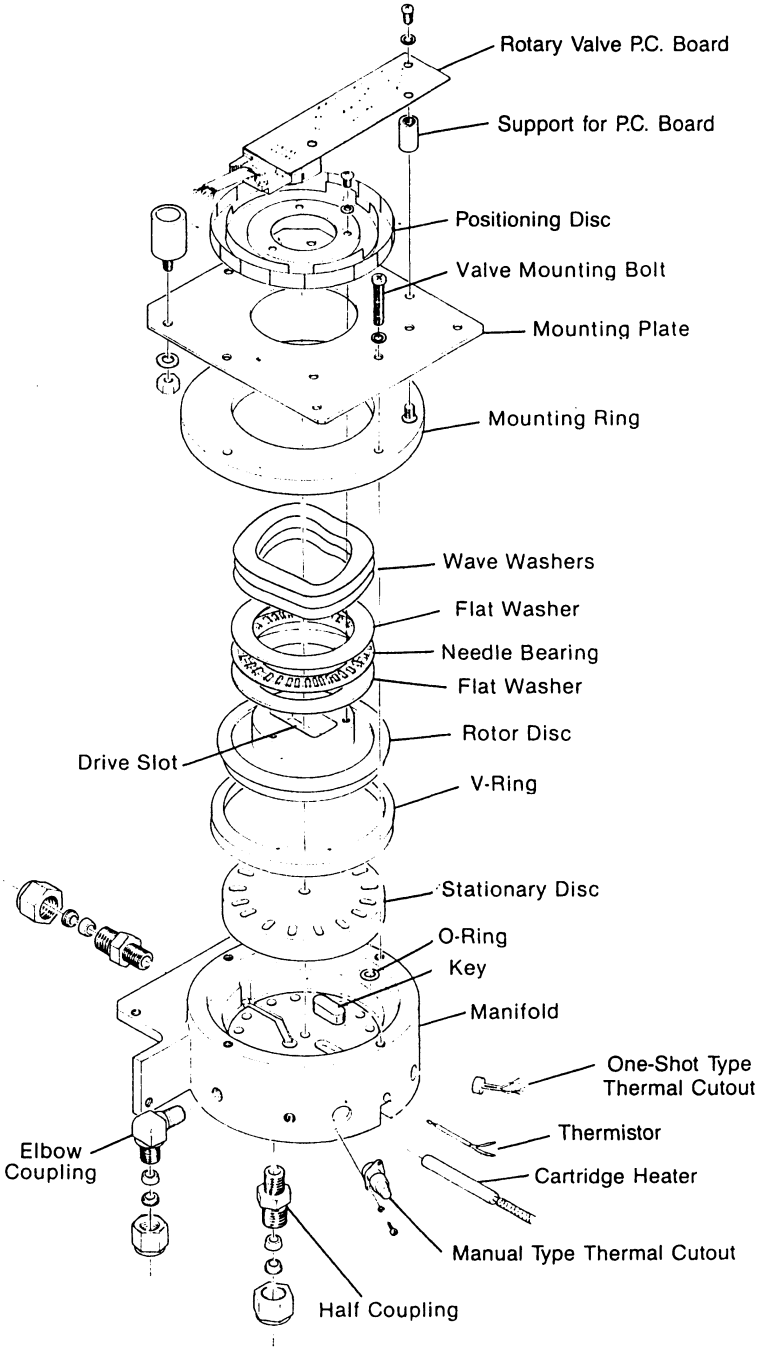


Figure 4-29. Rotary Valve, Exploded View

4-10-3 Reassembly of Rotary Valve.

To reassemble the rotary valve:

1. Lubricate both sliding halves of the rotary valve discs with a thin film of special grease (P/N 84617134).
2. Place parts on top of valve rotor in the following order:
   a. Flat washer
   b. Needle bearing
   c. Flat washer
   d. Three wave washer, aligned
3. Place mounting plate over valve rotor.
4. While holding mounting plate to rotor assembly, invert plate and reinstall stationary disc and Viton V-ring.

NOTE: Thin lip of ring should rest against ledge around stationary disc inside of valve housing.

5. Install mounting ring.
6. Rotate stationary disc to a postion which will permit key slot in its underside to engage key in bottom of the valve manifold when mounting plate with parts in place is positioned on manifold.
7. Rotate rotor so that length of drive slot is perpendicular to rear retort wall.
8. Reinstall the four mounting bolts, tightening front and rear bolts first.
9. Attach positioning ring to rotor. There is only one way the positioning ring can be attached since screw holes in rotor and ring are not located at equal angular intervals. Observe alignment marks on positioning ring and rotor. Be sure marks are aligned before tightening the three screws which hold ring to rotor.
10. Reattach position sensing P.C. Board. Observe carefully that there are copper printed circuit trace tabs extending to the edges of the board. Board must be fastened in such a position that copper trace tabs at both sides of P.C. board are directly above the concentric position signaling rings.
11. Pick up motor and gearhead assembly. Use a crescent wrench to rotate disc drive coupler (see figure 4-28) to a position which will permit it to enter drive slot in valve rotor when assembled to valve. Some force will be required to overcome resistance in gearhead.
12. Reinstall motor and gearhead assembly and fasten it in place. Tighten captive screws to 6-10 kg cm. Check torque after tightening.
13. Reconnect connector to terminal board.
14. Reconnect wires to terminal block and attach terminal block cover.
15. Apply power to instrument, and by manual entry on the keyboard, perform pump-in, pump-out cycles at three randomly selected stations between 1 and 10. Observe the green LED's on the control board (refer to section 3) to verify proper operation.

4-10-4 Rotary Valve Cartridge Heater and/or Temperature Sensor Replacement. (See figure 4-29).

Tools required: (+) screwdriver, cutter knife, hand press, pliers.

To replace a cartridge heater or temperature sensor:

1. Trace leads to terminal block, and disconnect.
2. Clean away embedding RTV silicone adhesive as required, and remove device from mounting hole.
3. Remove wiring from harness. Cut cable ties as necessary.
4. Clean mounting hole.
5. Fully insert new cartridge heater, and embed with silicone RTV. (Cure time is 24 hrs.)
6. Dress leads into harness. Replace cut cable ties.

   NOTE: The cartridge heater should be fully inserted into the mounting hole.

7. Connect leads to terminal block.

4-10-5 Replacement of Resettable Thermal Cutout (over temperature protection on rotary valve). (See figure 4-29.)

Tools required: (+) screwdriver, radio pliers.

To replace resettable thermal cutout:

1. Pull sleeve connectors from cutout.
2. Remove two screws from cutout base plate.

NOTE: Cutout is sealed in place with RTV silicone adhesive. Work cutout out of mounting hole.

3. Remove cutout.
4. Clean mounting hole carefully.
5. Apply new silicone RTV to seal opening when inserting new cutout. (Cure time-24 hrs.) Fasten cutout in place with two screws.
6. Reattach sleeve connectors.

4-10-6 Replacement of Fusible Thermal Cutout. (See figure 4-29.)

Tools required: (+) screwdriver, cutter knife, hand press, pliers.

To replace the fusible thermal cutout:

1. Remove cutout from valve manifold.
2. Cut thermal cutout leads.
3. Splice leads of new cutout to remaining leads as follows:
   a. Strip all four leads about 1/4 inch.
   b. Place a piece of heat shrinkable tubing long enough to cover both ends of a crimp splice about 1/4 inch over leads of new thermal cutout.
   c. Move heat shrinkable tubing over each splice, taking care to overlap both ends of splice. Apply heat to shrink the tubing.

CAUTION

The surface of cutout shall make direct contact with valve body.

4. Attach thermal cutout to valve with silicone RTV. Allow 24 hrs. cure time.

NOTE: Outer end of cutout should be flush with valve manifold wall.

4-10-7 Replacement of Rotary Valve Thermistor.

Tools required: (+) screwdriver, cutter knife, pliers.

1. Remove rear plate of oven and control box cover. See figure 2-1.
2. Detach CN13 connector for thermistor from the control PC board and disconnect wires to rotary valve unit. Cut cable ties as necessary.
3. End of thermistor is embedded in valve manifold, and its mounting hole is blocked with silicone adhesive. Clear away silicone adhesive with a knife.
4. Pull out thermistor. See figure 4-29.
5. Clear away silicone adhesive remaining around hole.
6. Apply silicone adhesive to sensing part of new thermistor.
7. Insert new thermistor in mounting hole and apply silicone adhesive around entrance.
8. Connect thermistor leads to control PC board and attach CN13 connector.
9. Fasten oven rear plate and control box cover in place.

NOTE: Fully insert thermistor into mounting hole. Allow 24 hours cure time for silicone adhesive.

4-11 OVERFLOW TRAP

Cleaning instructions for overflow bottle are given in paragraph 2-1-1.

Tools required: (+) screwdriver, 2 double open-end spanners 17x19.

4-11-1 Replacement of Trap Bottle Cap. (See figure 4-30.)

To replace trap bottle cap:

1. Remove bottle.
2. Unscrew pad nut inside cap while holding bottle seal joint with a wrench to prevent turning.
3. Loosen yoke screw and remove cap.
4. When reassembling overflow trap, check and adjust overflow sensor, if necessary.

4-11-2 Replacement of O-ring. (See figure 4-30.)

To replace O-ring:

1. Remove bottle cap as instruted in paragraph 4-11-1.
2. Pull O-ring from tube.
3. When reassembling overflow trap, check and adjust overflow sensor, if necessary.

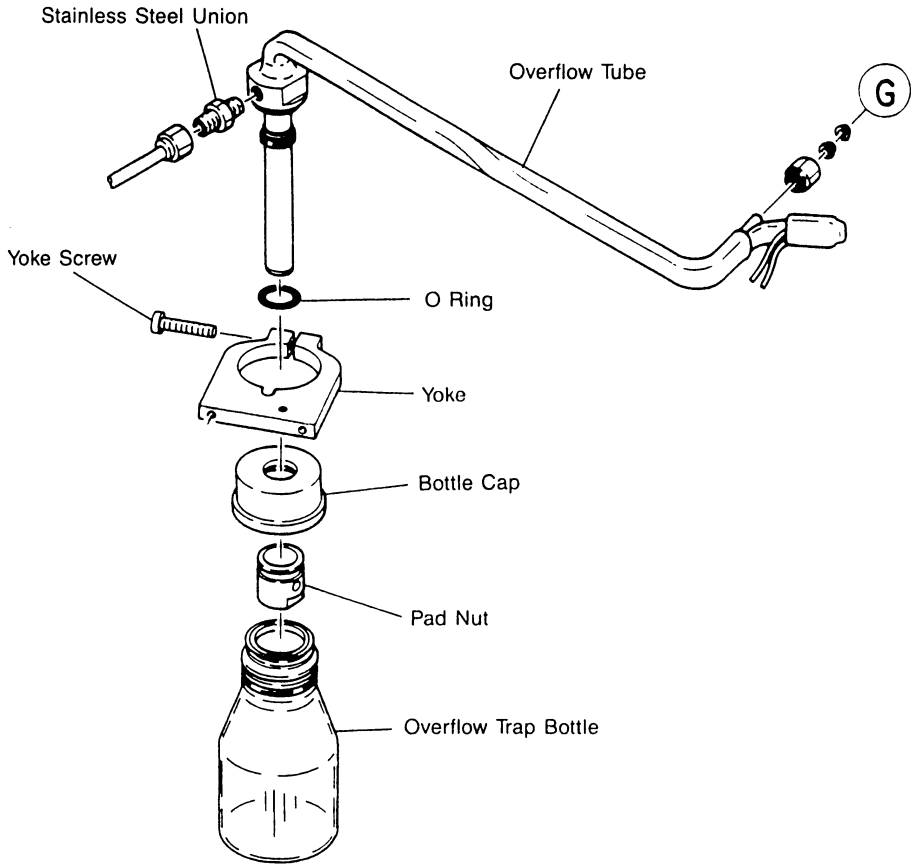


Figure 4-30. Overflow Trap, Exploded View

4-11-3 Replacement of Overflow Tube Heater. (See figures 4-30, 4-32, 4-33.)

Tools required: (+) screwdriver, 2 double open-end spanners 17x19, hand press, pliers, dryer.

To replace overflow tube heater:

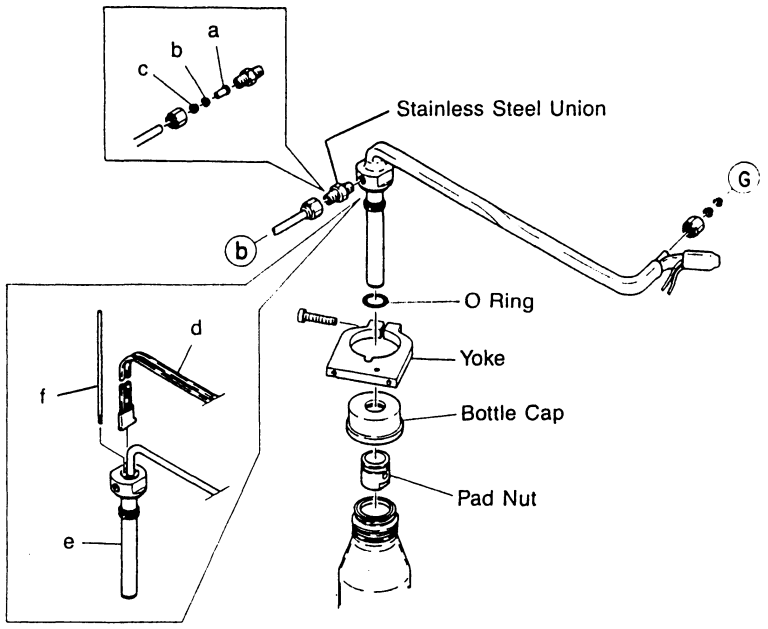
1. Remove bottle.
2. Disconnect overflow tube heater leads from terminal block at rear of oven.
3. Loosen coupling nut at air vent at the retort, and pull out overflow tube.

NOTE: In V.I.P. 2000 the left (front view) side angle brace of retort must be removed in order to pull out overflow tube.

4. Loosen coupling nut at union which connects overflow trap and air/vacuum system.
5. Loosen yoke screw, and remove overflow bottle fittings.

NOTE: Do not remove overflow sensor from processor.

6. Cut and remove heat shrinkable tubing which surrounds overflow tube and heater. Cut and remove glass cloth tape which binds heater to overflow tube. Cut heater near solderless terminal and separate heater from tube. See figure 4-31.
7. Cut a new heater to a length of about 60 cm. Expose solderless part to connect heater with the line cut in step 6.
8. Cut a suitable piece of heat shrinkable tubing to a length which will permit covering end of heater about 1/2 inch, and leaving about 3/4 inch fre Apply the tubing to open end of heater and shrink it into place.
9. Pinch open end of shrunken tubing with pliers, and trim length to about 5 mm beyond end of heater. See figure 4-32.
10. Insert open end of heater into overflow tube, then bind heater securely to overflow tube with glass cloth tape. The heater must contact the tub throughout its length. See figure 4-33.
11. Insert 6 mm OD Teflon tube of 13 cm length with pinched end into the double constructed overflow tube to contact heater with overflow tube.
12. Apply silicone adhesive to the slot.
13. Apply suitable size heat shrinkable tubing over entire length of both heater and overflow tubes, up to the stainless steel union. Shrink the tubing.
14. Reattach overflow tube to retort, and reassemble overflow system.
15. Attach leads of heater to terminal block at rear of oven.
16. Check overflow sensor. Adjust if necessary.



a. Insert 6 mm
b. Ferrule FF
c. Ferrule FR
d. Overflow Tube Heater
e. Overflow Tube
f. Teflon Tube

Figure 4-31. Replacement of Overflow Tube Heater

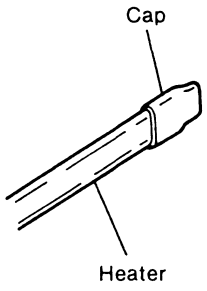


Figure 4-32. Cap on Overflow Tube Heater

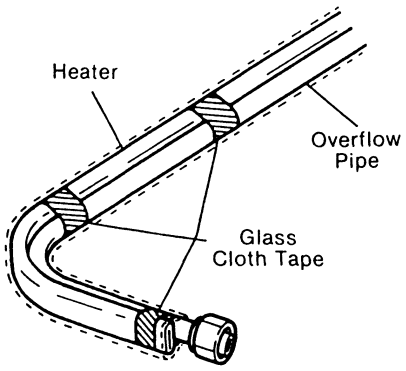
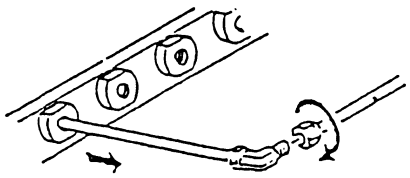
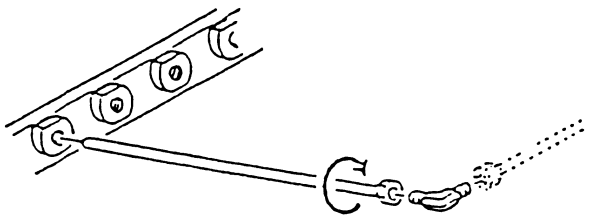


Figure 4-33. Attaching Overflow Tube Heater



(a)



(b)

Figure 4-34. Disassembly of Liquid Flow Tubing

4-12 SOLUTION STORAGE RACK

Tools required: (+) screwdriver, double open-end spanner 14x17, hexagon wrench 5 mm, tube cutter, cutter knife, monkey wrench.

4-12-1 Replacement of Teflon Liquid Flow Tubing.

NOTE: If tubing for reservoirs 1 through 7 is to be replaced, it is not necessary to pivot the air/vacuum sytem outward. For remaining reservoirs it is necessary to pivot the system as directed in paragraph 4-9-2.

To replace Teflon Liquid Flow Tubing:

1. Note orientation of stainless steel union at manifold. Union must be reassembled in same postion.
2. Loosen coupling nut of union at manifold. See figure 4-34(a).
3. Open union and pull out tubing.
4. Remove the other end of tubing from elbow which is in fluid line between reservoir and rotary valve. See figure 4-34(b).
5. Cut one end of new tubing to form a point (inverted 'v' as viewed from side of tubing.) See figure 4-35.
6. Assemble the new tubing so that pointed end will go into reservoir.

4-12-2 Replacement of Reservoir Cap Gaskets or O-Ring. (See figure 4-36.)

Tools required: (−) screwdriver (small).

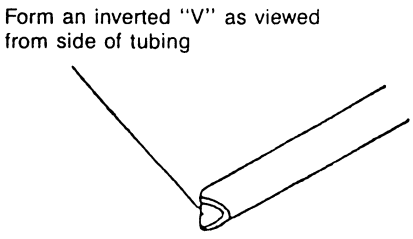


Figure 4-35. Cut in Teflon Tubing

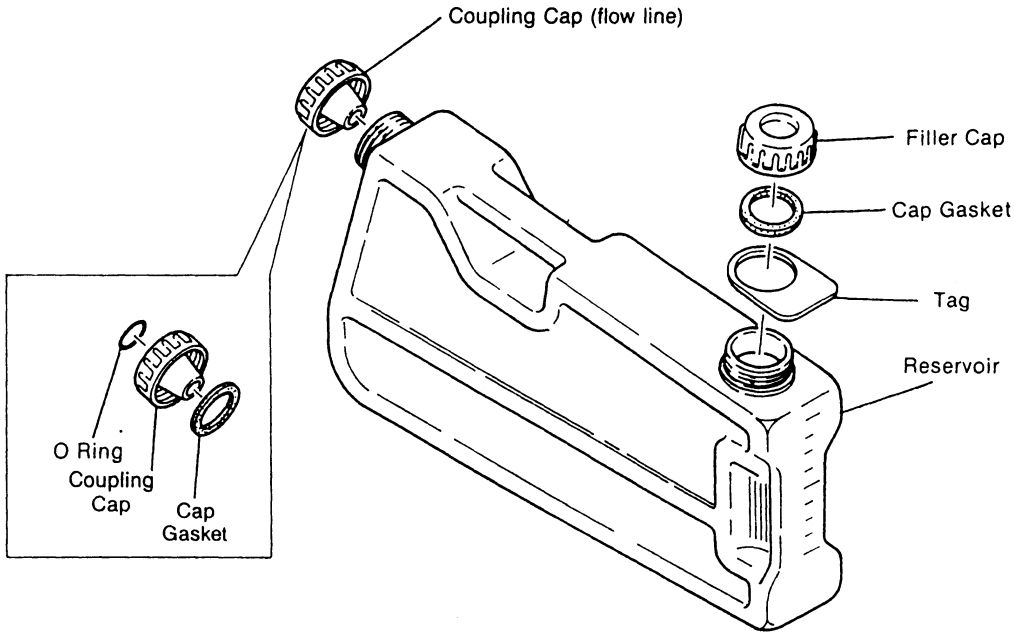


Figure 4-36. Reservoir Fittings

14-12-2-1. To replace an O-ring in the reservoir coupling cap, remove cap, then pry O-ring from its groove with a screwdriver. Apply petroleum jelly to new O-ring before seating it in groove.

4-12-2-2. To replace a gasket in either coupling cap, or filler cap, remove the cap, pry out gasket with a screwdriver, then force new gasket into place.

4-12-3 Replacement of O-Ring in Manifold. (See figure 4-37.)

Tools required: (–) screwdriver, hexagon wrench 5.5 mm.

NOTE: Pivot air/vacuum system outward only if lower manifold O-ring is to be replaced. See paragraph 4-9-2. To replace an O-ring in manifold:

1. Remove rear panel of processor behind air/vacuum system. See figure 2-1.
2. Pull out the Teflon tubing which passes through the O-ring to be replaced. See paragraph 4-12-1.
3. Remove sealing nut.
4. Apply petroleum jelly to new O-ring, and force ring into groove in sealing nut.

4-12-4 Replacement of Nozzle Gasket in Manifold. (See figure 4-37.)

Tools required: monkey wrench 250 mm, double open-end spanner 14x17, hexagon wrench 5.5 mm, (+) screwdriver.

NOTE: Pivot air/vacuum system outward only if lower manifold gasket is to be replaced. See paragraph 4-9-2.

1. Remove rear panel of processor behind air/vacuum system. See figure 2-1.
2. Remove reservoirs connected to ends of manifold.
3. Remove manifold attaching screws from inside rear panel of reservoir rack, and pull manifold toward rear of processor about 4 inches. (10cm)
4. Pull out Teflon tube passing through the gaske' be replaced. See paragraph 4-12-1.
5. Remove sealing nut and reservoir nozzle.
6. Replace gasket on reservoir nozzle. Assemble nozzle to sealing nut, and tighten nut.

NOTE: Insert nozzle into manifold so that flat of nozzle collar is at the bottom of manifold, facing rotation stop.

4-12-5 How to Drain Condensate from Air Manifold.

Tools required: (+) screwdriver.

1. Remove the rear panel behind the solution reservoir rack. See figure 2-A.
2. Place a small tray and remove a screw for a removable seal at the left bottom side of the lower air manifold.
3. After draining liquid condensate into the tray, reattach seal with screw.

4-12-6 Cleaning of Teflon Tubing for Fluid Vapor Treatment.

Tools required: (+) screwdriver, double open-end spanner 14x7.

1. Open the glass doors of the solution reservoir rack and remove water reservoir to determine whe r the Teflon tubing is clogged with paraffin.

2. Remove the rear panel of the solution reservoir rack and inspect not to block the tubing between the vent of the aspirator and the water reservoir with paraffin.
3. If the tubing is clogged with paraffin, remove it from the elbow union of the lower air manifold, and then heat it with a dryer to remove paraffin. To clear tubing inside water reservoir, pull out it toward the manifold and then heat it.

NOTE: Take care not to over-heat the Teflon tubing.

4-12-7 Replacement of Reservoir Compartment Doors. (See figure 4-38.)

Tool required: (+) screwdriver.

To replace a reservoir compartment door:
1. Remove screws which attach door to hinge.
2. Attach new door.
3. Affix a door cushion 10 mm from the edge of door.
4. Affix a magnetic latch plate to the inside surface of the cushion.
5. Adjust the position of the new door, if necessary, so that the two doors are aligned horizontally.

4-13 BATTERY REPLACEMENT (See figure 4-39.)

Tool required: (+) screwdriver.

The battery should be replaced when all LED decimal points on the numerical display illuminate or flash.

To replace battery:

NOTE: Instrument power should be off.

WARNING

Do not short circuit battery; explosion can result.

1. Remove battery compartment cover at rear of control box.
2. Loosen screws on battery clips on P.C. board.
3. Remove mating terminal from battery and remove battery.
4. Attach new battery to P.C. board. Be sure polarity is correct.
5. Reprogram processing programs and END TIME.

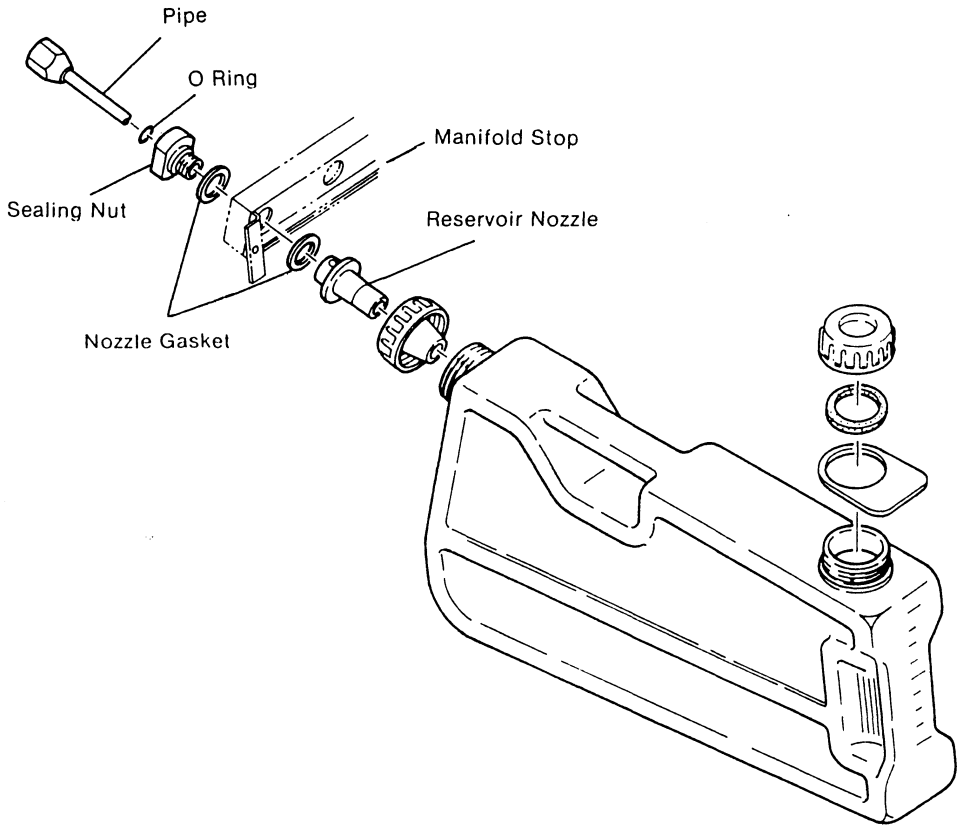


Figure 4-37. Manifold Fittings

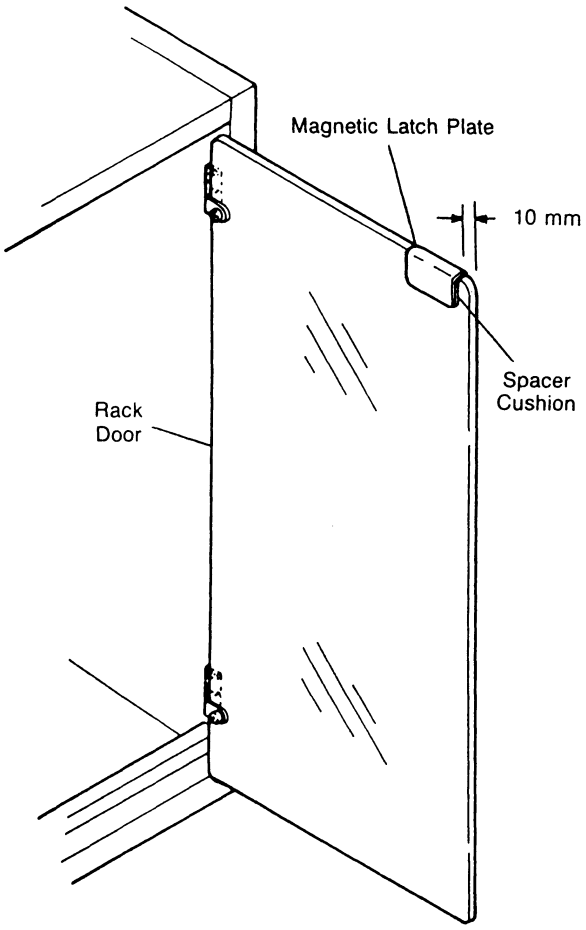


Figure 4-38. Reservoir Compartment Door

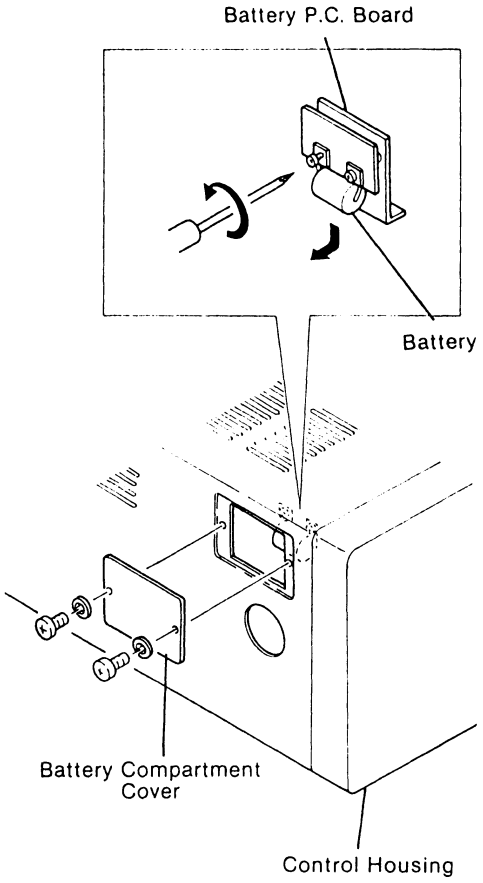


Figure 4-39. Battery Replacement

4-14 LINE VOLTAGE ADJUSTMENT (See figure 4-40.)

The processor can be adjusted to line voltages between 100 and 115 VAC, or between 220 and 240 VAC.

Tool required: (+) screwdriver.

WARNING
Shut off power to processor.

To adjust line voltage:

1. Shut off power to processer and remove control box cover.
2. Disconnect all connectors from control board. See paragraph 4-5-2.
3. Remove screws which fasten power chassis cover. (Control board is mounted on chassis cover).
4. Lift power chassis cover with control board attached. See figure 4-7.
5. Remove cover from terminal strip inside power chassis.
6. Note that there are two wires connected to terminal strip; one to 0V (low side), the other to one of two terminals . Do not disconnect the wire connected to 0V.
7. If your instrument operates on 100 to 115 Vac refer to subparagraph a. If your instrument operates on 220 to 240 Vac refer to subparagraph b.
   a. 100-115 V instrument. The high side wire should be connected to either the 100V or 115V terminal, whichever is closer to actual line voltage. Change connection if necessary.
   b. 220-240 V instrument. The high side wire should be connected to either the 220V or 240V terminal, whichever is closer to actual line voltage. Change connection if necessary.
8. When reassembling, do not cross-connect CN8 and CN9 connectors.

4-15 TRIACS

Three triacs are mounted on the rear of the power chassis. (See figure 4-40.) As seen from the rear of the processor they are:

Left-Oven
Center-Rotary Valve
Right-Retort

WARNING
Shut off power to processor.

To replace a triac:

1. Shut off power to processor.
2. Note positions of leads on triac and unsolder leads of triac to be replaced.
3. Remove two attaching screws and pull triac out.
4. Install new triac.
5. Solder leads to triac being careful to attach each lead to correct terminal on triac.

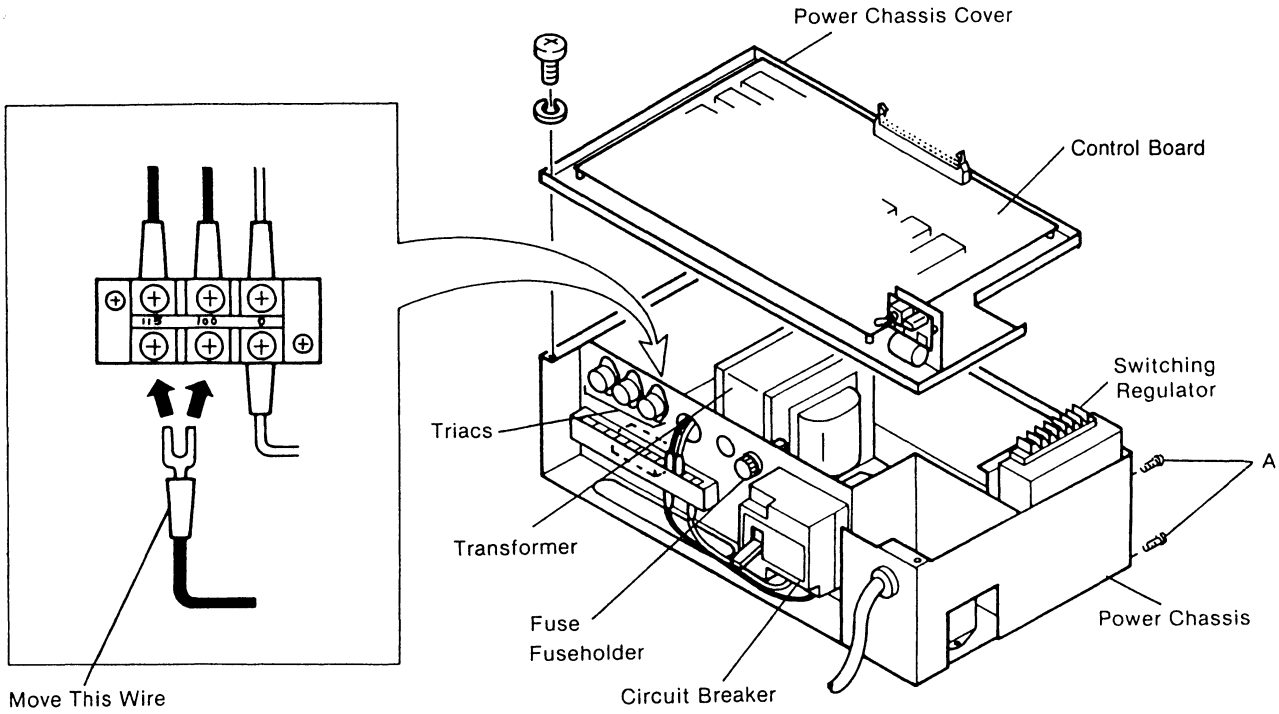


Figure 4-40. Line Voltage Adjustment

SECTION 5 PARTS LIST

Replaceable parts of the Tissue Tek V.I.P. 1000/2000/3000 are shown in figures 5-1 through 5-12 in this section. The parts shown in each illustration are listed in order of callout number.

An additional feature of the illustrations is the assembly guide, which consists of alphabetical callouts. Both uppercase and lowercase letters are used.

To find mating or connecting parts, look for corresponding alphabetical callouts, not necessarily in the same illustration. For example, M in figure 5-6 is connected to M, figure 5-9.

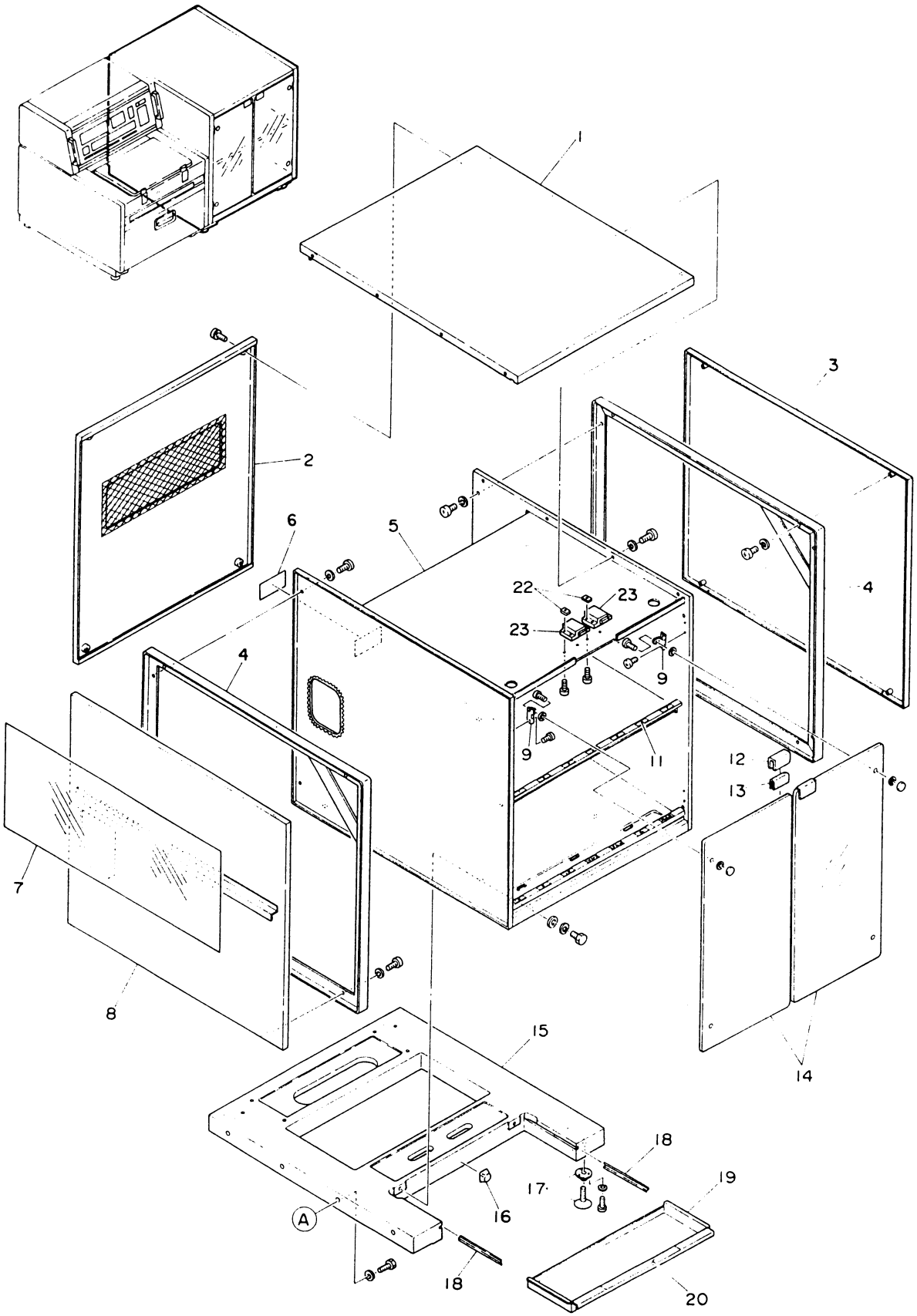


Figure 5-1. Reservoir Housing Exploded View

FIGURE & INDEX NUMBER	AMES P/N	DESCRIPTION	VENDOR P/I
5-1-1		Reservoir Rack Top Cover, 1000/2000, Floor	060-606-0
		Reservoir Rack Top Cover, 1000/2000, Bench	060-605-0
		Reservoir Rack Top Cover, 3000, Bench	063-605-0
		Reservoir Rack Top Cover, 3000, Floor	)-606-0
-2		Reservoir Rack Rear Panel, 1000/2000	060-609-0(
		Reservoir Rack Rear Panel, 3000	063-609-0(
-3		Right Side Panel 1000/2000	060-603-0:
		Right Side Panel, 3000	063-603-0(
-4		Side Angle Frame, 1000/2000	060-620-0(
		Side Angle Frame, 3000	063-620-0(
-5		Reservoir Rack, 1000/2000	060-419-0:
		Reservoir Rack, 3000	063-419-0(
-6		Caution Label, 1000/2000	B5-04-061
		Caution Label, 3000	B5-04-066:
-7		Protective Sheet	060-914-0
-8		Left Side Panel, 1000/2000, Bench	060-602-0:
		Left Side Panel, 3000, Bench	063-602-0(
		Left Side Panel, 1000/2000, Floor	060-601-0
		Left Side Panel, 3000, Floor	063-601-0
-9	84617002	Hinge	D9-04-004(
-10	84617003	Door Stop	D9-04-019:
-11		Number Plate, Upper	060-426-0
-12	84617004	Magnet Latch Receiver	D9-04-019
-13	84617005	Spacer Cushion	D9-04-019:
-14	84617118	Door, 1000/2000	060-420-0
	84617253	Door, 3000	063-420-0(
-15		Base	061-615-0-
-16		Tray Stop	D9-03-013(
-17	84617006	Adjustable Foot, Bench only	D9-03-013-
	84617254	Caster, Rear, Floor only	D9-20-003:
	84617255	Caster with Brake, Front, Floor only	20-005:
-18		Guide Rail	060-330-0(
-19	84617215	Spill Tray	060-334-0(
-20	84617216	Caution Label	B5-04-074(
-21		Number Plate, Lower	060-427-0:
-22		Washer, Nut	063-622-01
-23	84617011	MC Latch	D9-04-019:

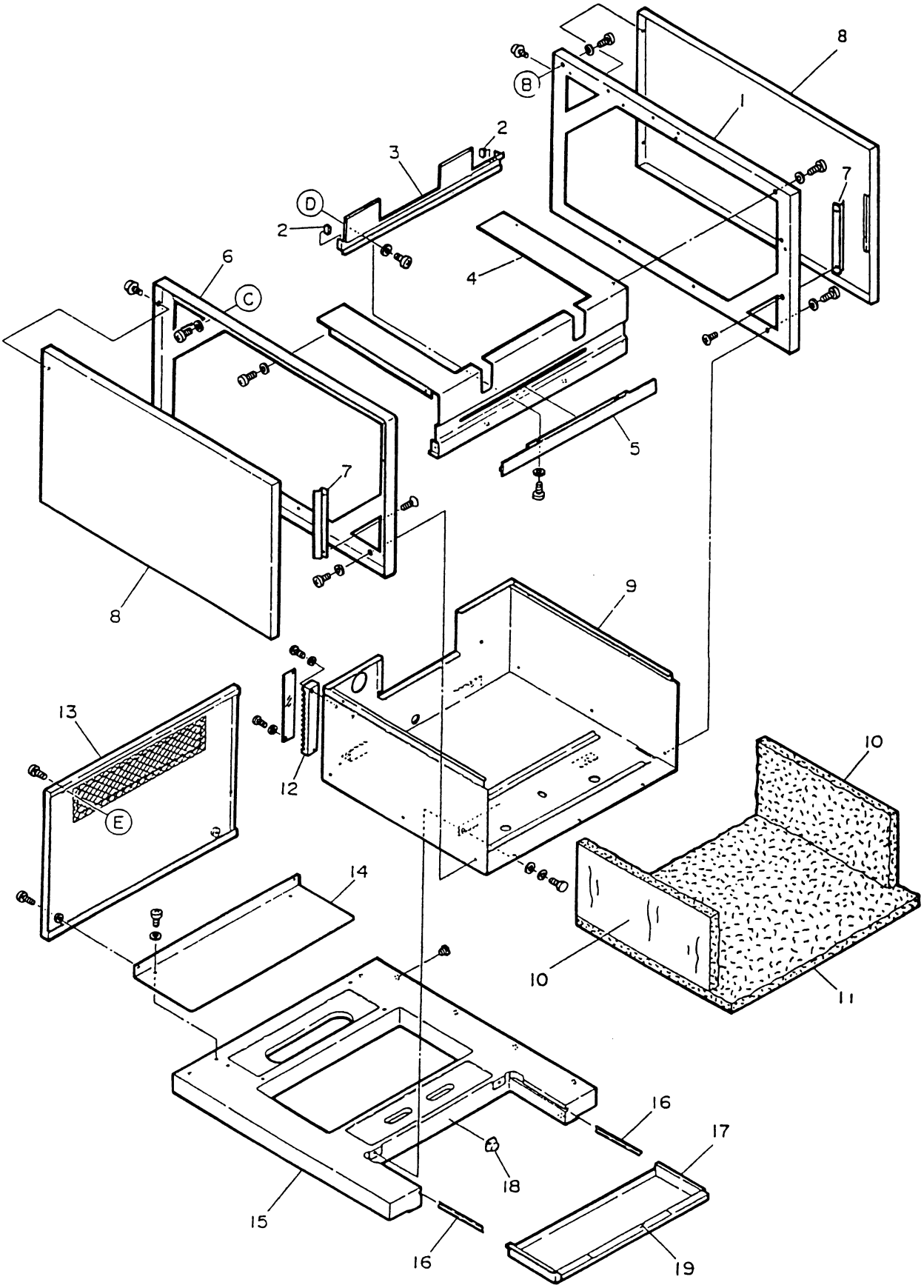


Figure 5-2. Lower Housing, Exploded View

FIGURE & INDEX NUMBER	AMES P/N	DESCRIPTION	VENDOR P/N
5-2-1		Right Side Angle Frame, 1000/2000	061-619-02
		Right Side Angle Frame, 3000	063-619-00
-2		Bumper	0[illegible]217-00
-3		Carrier	[illegible]209-03
-4	84617251	Retort Brace, 1000	060-211-05
	84617213	Retort Brace, 2000	061-211-06
		Retort Brace, 3000	063-211-03
-5	84617103	Interlock Bar	061-210-02
-6		Left Side Angle Frame, 1000/2000	060-617-02
		Left Side Angle Frame, 3000	063-617-00
-7		Spring	060-607-01
-8		Side Panel, 1000/2000	060-601-01
		Side Panel, 3000	063-601-00
-9		Lower Housing	060-311-01
-10		Insulating Material, Side	060-336-00
-11		Insulating Material, Bottom	060-339-00
-12	84617018	Terminal Block	A4-05-0007
-13		Rear Panel, 1000/2000	060-608-02
		Rear Panel, 3000	063- 00
-14		Case Attaching Bracket, Bench	061-[illegible]-04
		Case Attaching Bracket, Floor	060-611-04
-15		Base	061-613-03
-16		Guide Rail, 1000/2000	060-330-00
		Guide Rail, 3000	060-333-00
-17	84617215	Spill Tray	060-334-00
-18		Stop	D9-03-0136
-19	84617216	Caution Label	B5-04-0740

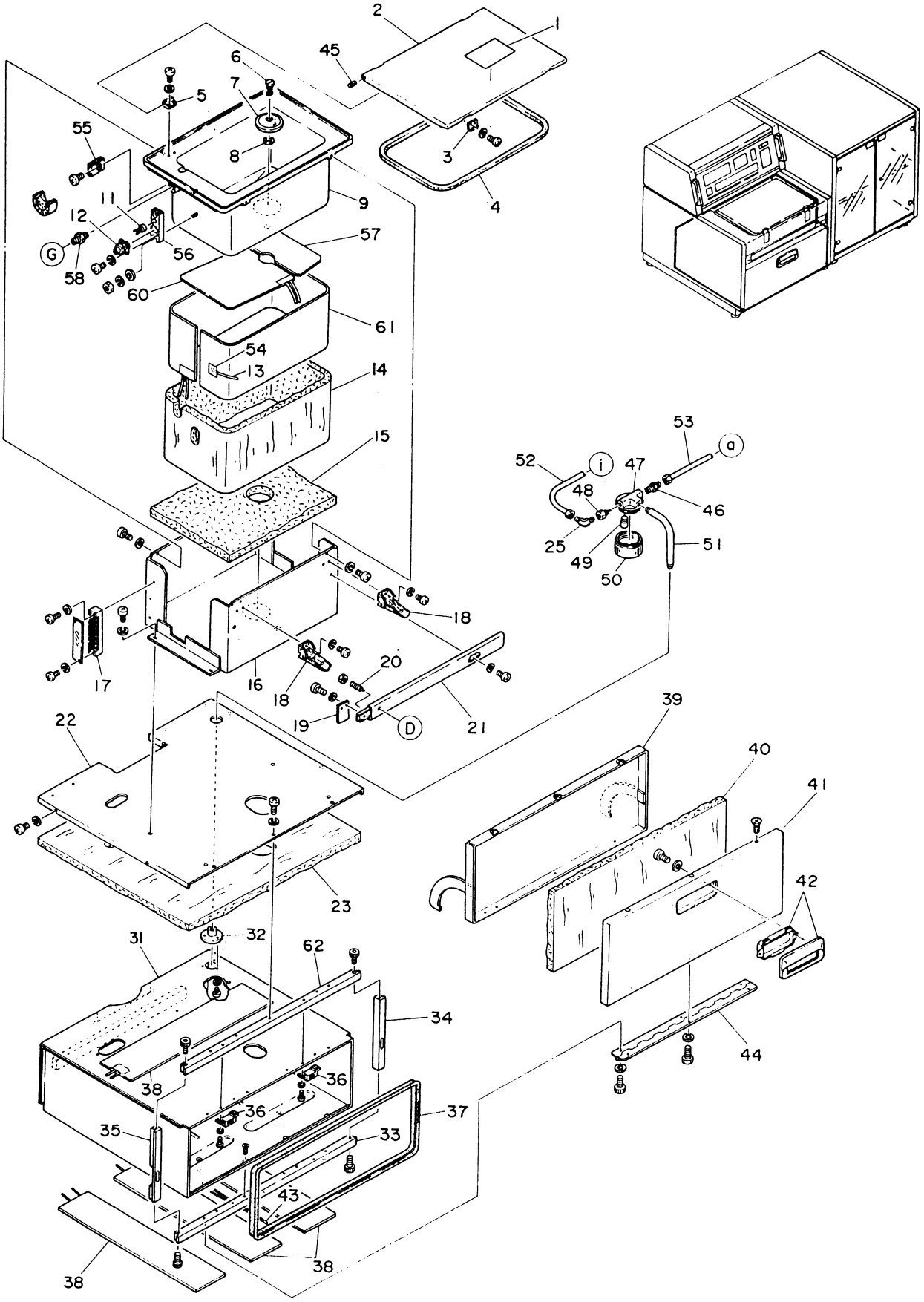


Figure 5-3. Retort Housing, Exploded View

FIGURE & INDEX NUMBER	AMES P/N	DESCRIPTION	VENDOR P/N
5-3-1		Retort Label	B5-04-0730
-2	84617256	Retort Cover, 1000	060-201-03
	84617214	Retort Cover, 2000/3000	061-201-04
-3	84617104	Latch Hook	060-213-03
	84617045	Retort Gasket, 1000	060-212-00
-4	84617148	Retort Gasket, VIP 2000/3000	[illegible]-212-00
-5	84617008	Fulcrum Metal Hinge	060-202-03
-6	84617022	Weight for Filter	060-216-02
-7	84617102	Retort Inlet/Outlet Filter	060-204-04
-8	84617072	E-ring	B6-70-2001
-9	84617009	Retort, Complete, 1000	
	84617010	Retort, Complete, 2000	
	84617230	Retort, Complete, 3000	
-11	84617041	Fusible Thermal Cutout	A3-40-1170
-12	84617042	Resettable Thermal Cutout	A3-40-1200
-13	84617028	Retort Thermistor	A5-00-4870
-14	84617224	Insulating Material, Retort Side, 1000	060-220-00
	84617225	Insulating Material, Retort Side, 2000	061-220-00
	84617226	Insulating Material, Retort Side, 3000	063-220-00
-15	84617227	Insulating Material, Retort Bottom, 1000	060-219-00
	84617228	Insulating Material, Retort Bottom, 2000	061-219-00
	84617229	Insulating Material, Retort Bottom, 3000	06[illegible]-00
-16		Retort Retaining Frame	063-207-01
-17	84617016	Terminal Block	A4-05-0005
-18	84617043	Manual Latch	060-214-00
-19	84617124	Retort Interlock Detector PCB A5-00-4760	
-20		Spring Plunger	A4-06-0637
-21	84617007	Slide Rail	060-208-02
-22		Oven Compartment Top, 1000	060-312-00
		Oven Compartment Top, 2000	061-312-00
		Oven Compartment Top, 3000	063-312-00
-23		Insulating Material, Oven Top, 1000	060-337-00
		Insulating Material, Oven Top, 2000	061-337-00
		Insulating Material, Oven Top, 3000	[illegible]-337-00
-25	84617069	Elbow	[illegible]27-5120
-31		Oven Top, 1000/2000	063-303-04
		Oven Top, 3000	063-303-01
-32		Exhaust Port	060-305-01
-33		Oven Frame, Bottom	060-308-01
-34		Oven Frame, Right	060-310-01
-35		Oven Frame, Left	060-309-01
-36	84617011	Magnetic Catch	D9-04-0180
-37	84617049	Oven Gasket	060-307-01
-38	84617048	Oven Heater, 120W, 100/115 V	060-[illegible]01-02
	84617151	Oven Heater, 120W, 220/240 V	060-335-02
-39		Oven Door Back Plate	060-320-03
-40		Insulating Material, Oven Door	060-338-00
-41	84617250	Door Outer Plate	060-321-01
-42		Handle	B5-20-0390
-43	84617152	Oven Thermistor	A5-00-4860
-44		Hinge	060-322-00
-45	84617044	Spring Pin	B6-65-2002
-46	84617078	Union	A6-27-5140
-47	84617219	Aspirator	060-519-01
-48	84617218	Nozzle	060-518-00
-49		Short Pipe	060-521-00
-50	84617220	Cup	060-520-02

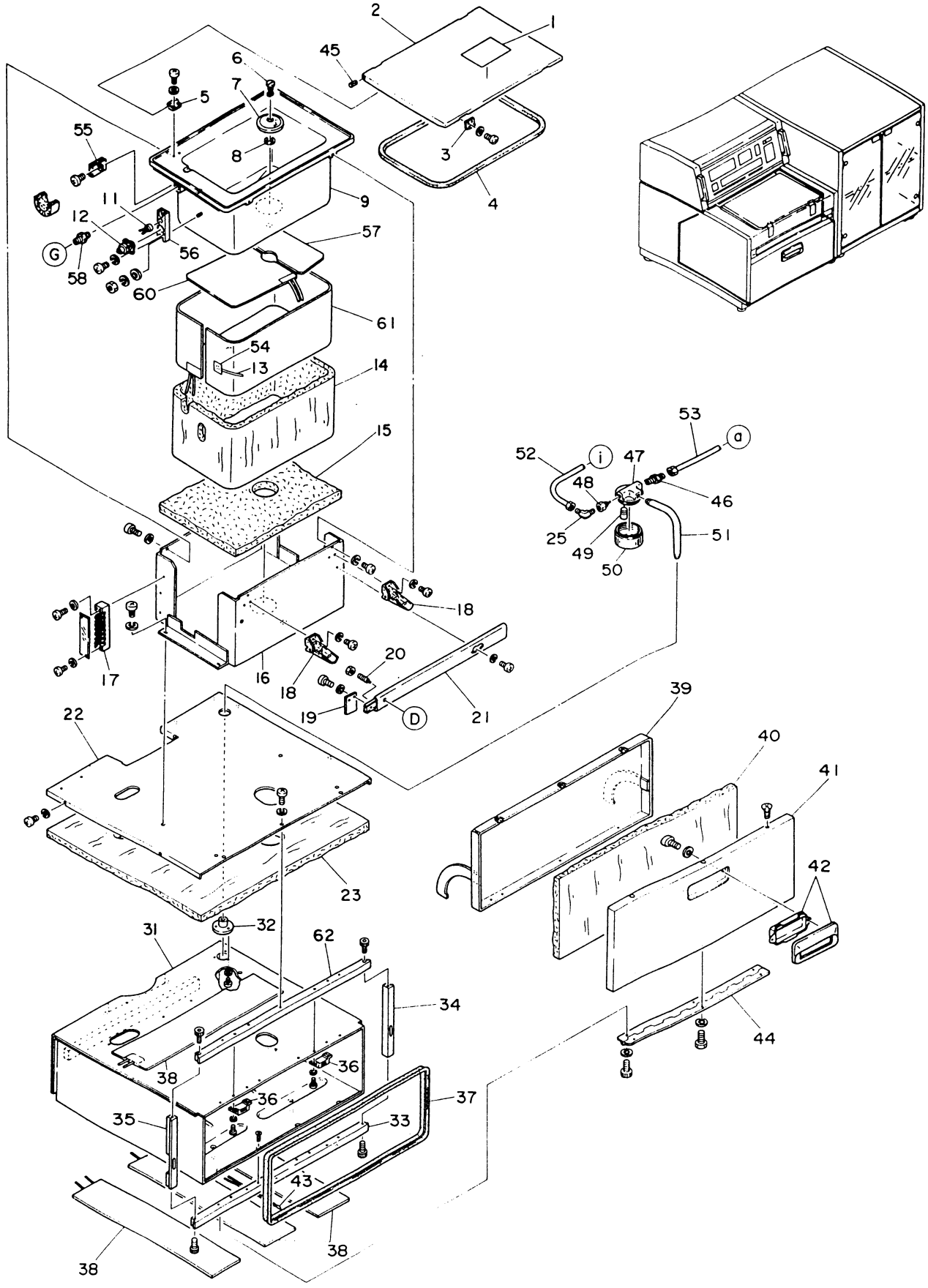


Figure 5-3. Retort Housing, Exploded View

FIGURE & INDEX NUMBER	AMES P/N	DESCRIPTION	VENDOR P/N
5-3-51		L-pipe	060-522-01
-52		Teflon Tube, 6mm	060-533-01
-53		Teflon Tube, 8mm	060-543-01
-54		Thermistor Cover	232-00
-55	84617221	Air Connection Heater, 2W, 100V/115V	060-238-02
		Air Connection Heater, 2W, 220V/240V	061-238-01
-56		Thermal Cutout Housing	060-231-00
-57	84617138	Retort Heater, Bottom, 60W, 100V/115V, 1000	060-228-00
		Retort Heater, Bottom, 60W, 220V/240V, 1000	060-230-00
	84617140	Retort Heater, Bottom, 90W, 100V/115V, 2000	061-228-00
		Retort Heater, Bottom, 90W, 220V/240V, 2000	061-230-00
-58	84617055	Half Union	A6-27-5030
-60	84617222	Retort Heater, Bottom, 120W, 100V/115V,3000	063-228-00
		Retort Heater, Bottom, 120W, 220V/240V, 3000	063-230-00
-61	84617137	Retort Heater, Side, 340W, 100V/115V, 1000	060-227-00
		Retort Heater, Side, 340W, 220V/240V, 1000	060-229-00
	84617139	Retort Heater, Side, 410W, 100V/115V, 2000	061-227-00
		Retort Heater, Side, 410W, 220V/240V, 2000	061-229-00
	84617223	Retort Heater, Side, 550W, 100V/115V, 3000	063-227-01
		Retort Heater, Side, 550W, 220V/240V, 3000	063-229-01
-62		Oven Frame, Top 1000/2000	060-308-00
		Oven Frame, Top, 3000	063-308-00
Not Numbered	84617067	Tubing, 6mm, 1 meter	B7-25-0020
Not Numbered	84617200	Tubing, 8mm, 1 meter	B7-25-0010

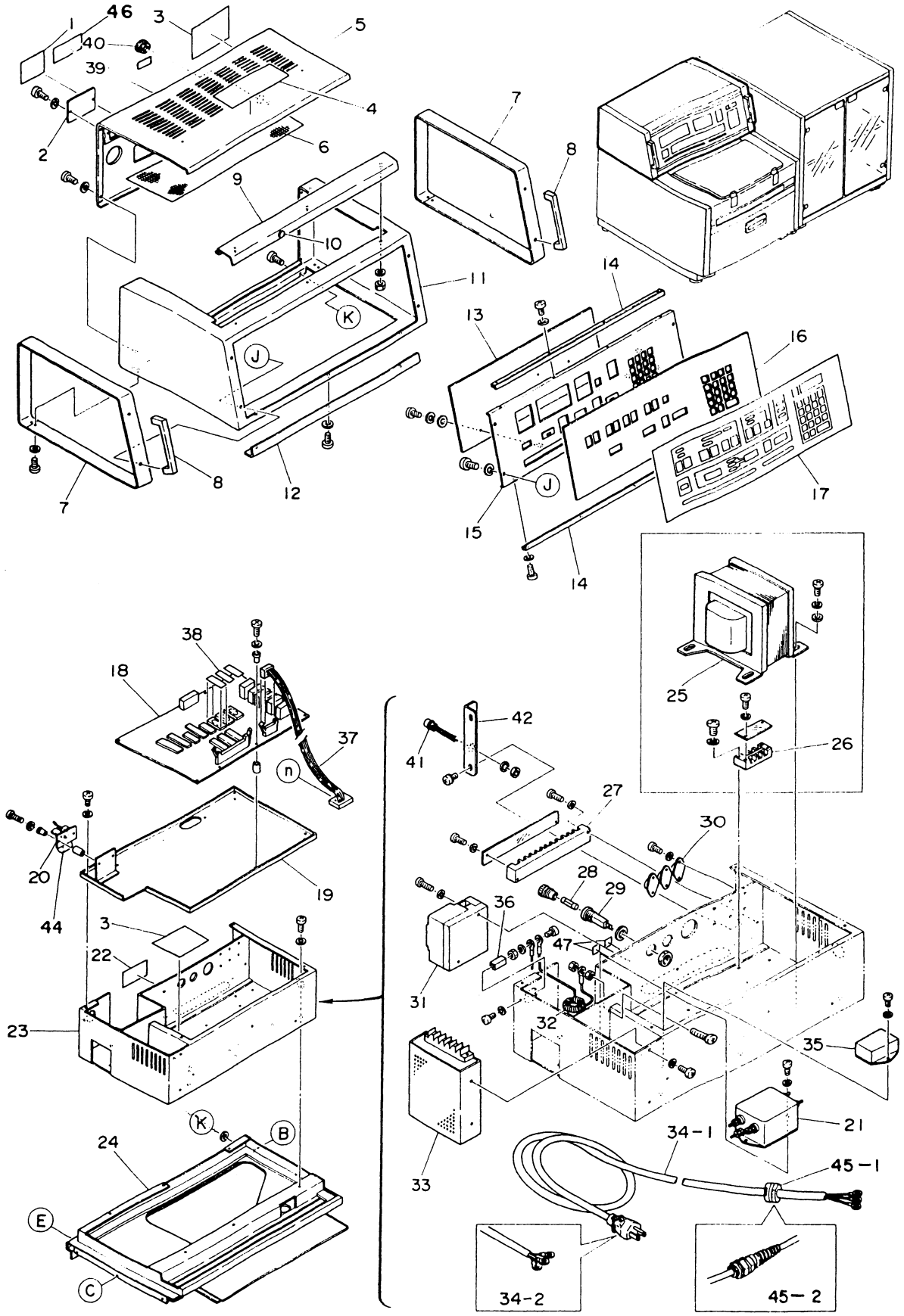


Figure 5-4. Control Housing, Exploded View

FIGURE & INDEX NUMBER	AMES P/N	DESCRIPTION	VENDOR P/N
5-4-1		Rating Plate, 115 V (1000)	B5-01-2833
		Rating Plate, 220 V/240 V (1000)	B5-01-2850
		Rating Plate, 115 V (2000)	B5-01-2843
		Rating Plate, 220 V/240 V (2000)	1-2860
		Rating Plate, 115 V (3000)	B5-01-3100
		Rating Plate, 220 V/240 V (3000)	B5-01-3200
-2		Battery Compartment Cover	060-806-01
-3		Caution Label, 115V	B5-04-0690
		Caution Label, 220V	B5-04-0700
		Caution Label, 240V	B5-04-0710
-4		Caution Label	B5-04-0670
-5		Control Box Cover	060-812-08
-6		Dust Mesh	D9-70-0090
-7		Decorative Frame	060-804-03
-8	84617085	Handle	B5-20-0400
-9		Upper Panel Plate	060-802-04
-10		Rubber Bumper	D9-03-0135
-11		Control Housing	060-813-05
-12		Lower Panel Plate	060-803-03
-13	84617120	Panel PC Board	A5-[illegible]-02
-14		Pad	060-808-02
-15		Panel Support	060-809-04
-16		Display and Programming Panel	061-811-04
-17	84617073	Panel Overlay	061-816-02
-18	84617123	Control PCB (needs 3 EPROMs—see item 38)	A5-00-4720
	84617242	Control PCB (needs 1 EPROM—See item 38)	A5-00-4780
-19		Power Box Chassis Cover	060-807-04
-20	84617122	Battery P.C.B.	A5-00-4730
-21	84617097	Line Noise Filter	A3-60-8100
-22		Label, Fuse Capacity, 1000/2000	B5-04-0620
		Label, Fuse Capacity, 3000	B5-04-0621
-23		Power Chassis 100V/115V	[illegible]10-11
		Power Chassis 220V/240V	06[illegible]810-13
-24	84617252	Top Plate, 1000	060-616-06
	84617242	Top Plate, 2000	061-616-07
		Top Plate, 3000	
-25	84617093	Transformer 100V/115V	A3-20-0730
	84617153	Transformer 220V/240V	A3-20-0720
-26	84617017	Terminal Block	A4-05-0002
-27	84617018	Terminal Block	A4-05-0007
-28	84617087	Fuse, 3A	A3-4[illegible]70
-29	84617086	Fuse Holder	A3-43-0280
-30	84617098	Triac	A3-60-6140
-31	84617099	Circuit Breaker	A3-10-6330
-32	84617094	SN Coil	A3-90-3040
-33	84617095	Switching Regulator	A3-16-0030
-34-1	84617089	Power Cord, 115V	F80-074-03
-34-2	84617154	Power Cord, 240V	F80-075-01
-35	84617096	Noise Filter	A3-60-8050
-36		Collar	060-818-00
-37	84617125	Flat Cable	060-712-00
-38	84617081	EPROM Set (3 each), 1000/2000 (original models)	B5-03-3940
		EPROM Set (3 each), 3000 (original model)	B5-03-3941
	84617236	EPROM 951, 1 Piece, 1000/2000	060-951-01
	84617237	EPROM 951, 1 Piece, 3000	063-951-01
	84617240	EPROM 952, 1 Piece, 1000/2000	060-952-01
	84617241	EPROM 952, 1 Piece, 3000	063-952-01
	84617238	EPROM 953, 1 Piece, 1000/2000	060-953-01
	84617239	EPROM 953, 1 Piece, 3000	063-953-01

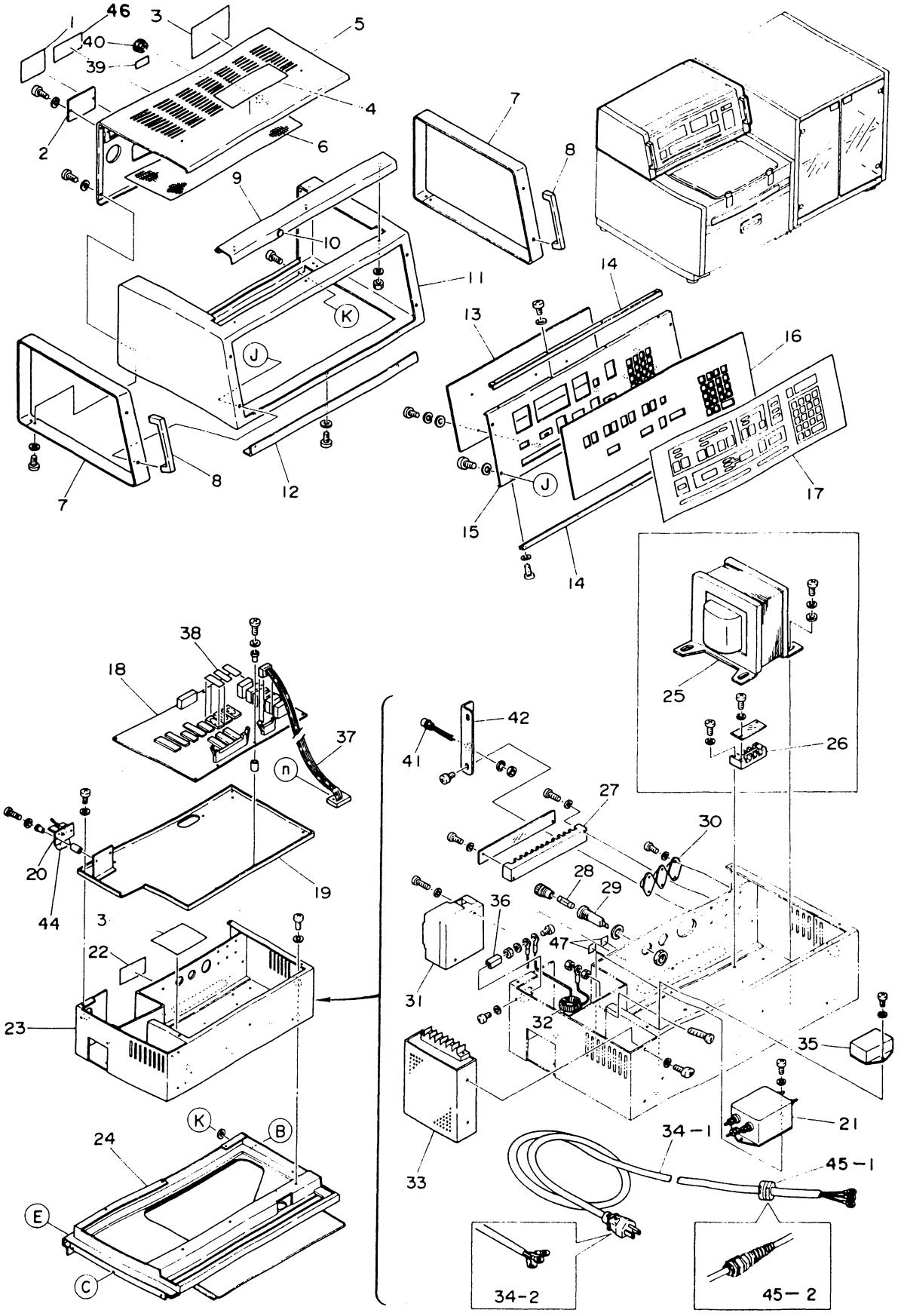


Figure 5-4. Control Housing, Exploded View

FIGURE & INDEX NUMBER	AMES P/N	DESCRIPTION	VENDOR P/N
5-4-39		Label, External Alarm	B5-04-0770
-40		Grommet	A4-07-0307
-41	84617182	Receptacle, External Alarm	A4-06-0689
-42		Receptacle Brace	819-00
-44	84617184	Battery, Lithium	A5-50-0040
-45-1		Cord Bushing, 100V/115V	A4-07-0208
-46		Main Input Label (L.N.E.), 220V/240V	B5-03-4281
Not Shown	84617179	Relay, External Alarm	
Not Shown	84617183	Plug, External Alarm	A4-06-0690

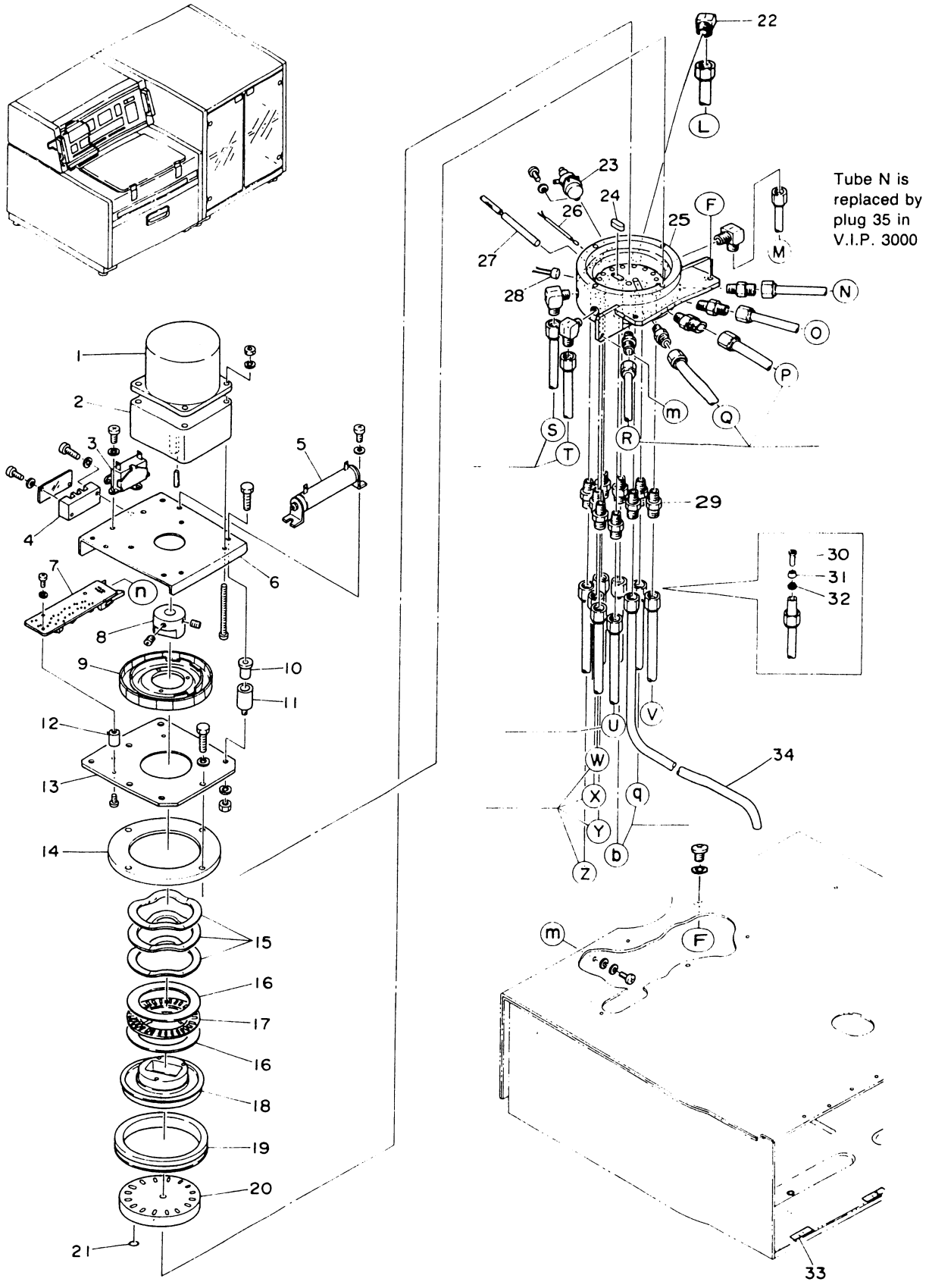


Figure 5-5. Rotary Valve, Exploded View

FIGURE & INDEX NUMBER	AMES P/N	DESCRIPTION	VENDOR P/N
5-5-1	84617013	Motor	A0-01-0410
-2	84617030	Gear Head	A0-70-0561
-3	84617105	Capacitor	A3-30-3394
-4	84617017	Terminal Block	15-0002
-5	84617106	Resistor	[illegible]-33-2160
-6		Motor Mounting Plate	060-110-02
-7	84617121	Position Sensor P.C.B	A5-00-4750
-8	84617110	Coupling Valve Drive	060-105-03
-9	84617101	Positioning Disc	060-109-02
-10	84617032	Anti-Vibration Mount	D9-03-0217
-11		Spacer	060-103-01
-12	84617112	Support	D9-36-0020
-13		Spring Plate	060-107-02
-14	84617129	Spring Guide	060-108-01
-15	84617036	Wave Washer	D9-28-0050
-16	84617034	Bearing Washer	B0-03-4790
-17	84617033	Roller Bearing	B0-03-4780
-18	84617100	Rotary Disc	060-102-03
-19	84617035	V-Ring	B3-01-0060
-20		Stationary Disc (part of item 18)	060 [illegible]-03
-21	84617037	O-Ring	B3-00-0580
-22	84617020	Elbow	A6-27-5020
-23	84617042	Resettable Thermal Cutout	A3-40-1200
-24	84617161	Key	060-106-01
-25		Valve Housing	060-104-05
-26	84617155	Rotary Valve Thermistor	A5-00-4880
-27	84617031	Heater Cartridge, 84W, 100/115 V	060-111-01
	84617199	Heater Cartridge, 84W, 220/240 V	060-112-01
-28	84617041	Fusible Thermal Cutout	A3-40-1170
-29	84617038	Half Union	A6-27-5010
-30	84617025	Insert, Stainless Steel	D9-80-0201
-31	84617024	Ferrule, Stainless Steel	[illegible]0-0170
-32		Ferrule, Stainless Steel (part of item 31)	[illegible].0-0190
-33		Number Tag	060-909-02
-34		Drain Pipe	060-313-01
-35	84617246	Plug (No. 21)	A6-35-5010
Not Pictured	84617134	Rotary valve grease	D9-60-0030

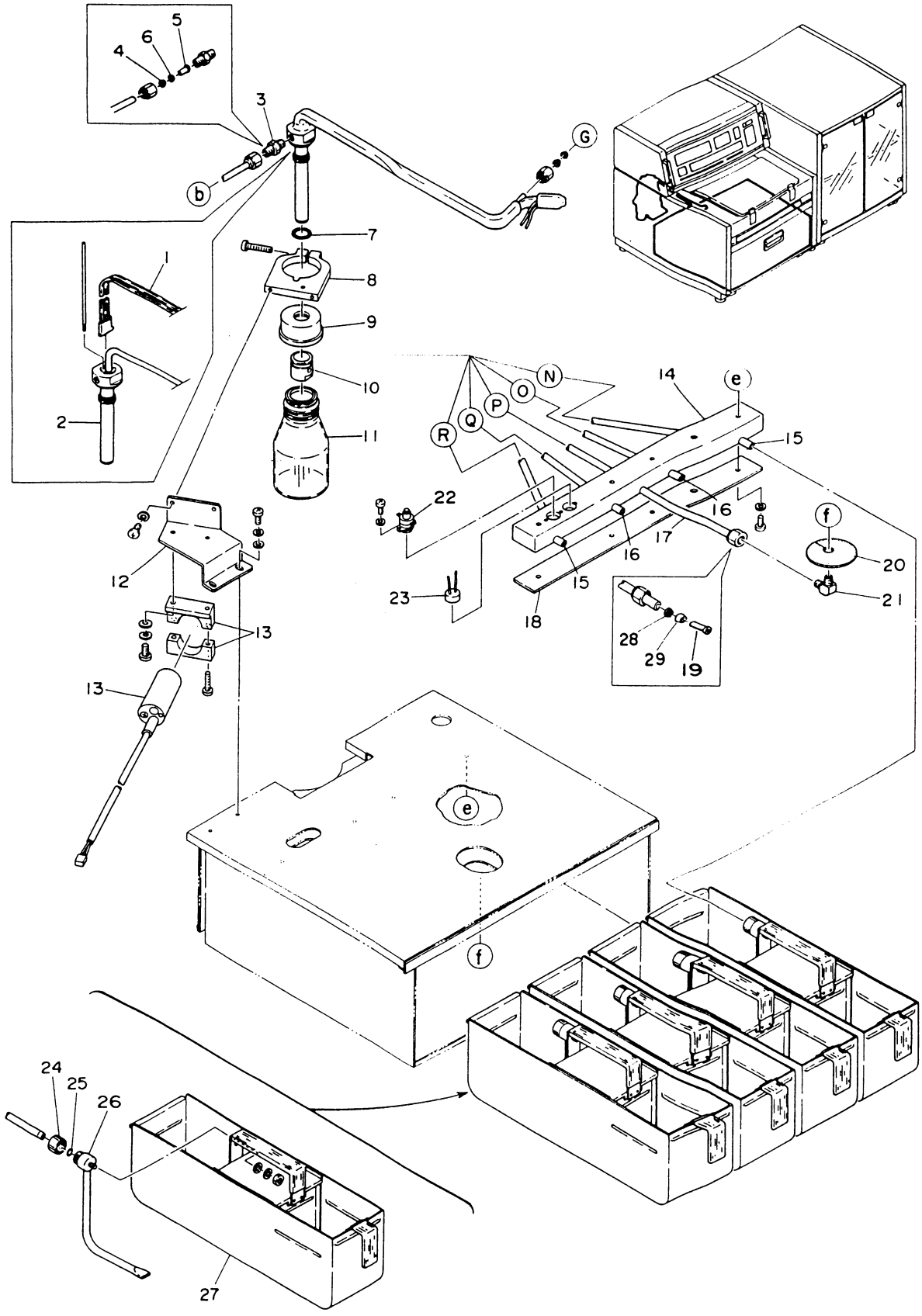


Figure 5-6a. Paraffin Tank Housing, Exploded View

FIGURE & INDEX NUMBER	AMES P/N	DESCRIPTION	VENDOR P/N
5-6-1	84617157	Overflow Tube Heater, 100V/115V	A1-21-0050
	84617158	Overflow Tube Heater, 220V/240V	A1-21-0040
-2	84617084	Overflow Tube Assembly	060-533-00
-3	84617055	Half Union, Stainless Steel	-27-5030
-4	84617026	Ferrule, Stainless Steel	D9-80-0180
-5	84617023	Insert, Stainless Steel	D9-80-0200
-6		Ferrule, Stainless Steel (part of item 4)	D9-80-0160
-7	84617053	O-Ring	B3-00-0680
-8		Bottle Yoke	060-507-02
-9	84617119	Bottle Cap	060-506-01
-10	84617162	Pad Nut	060-524-00
-11	84617051	Overflow Bottle	B4-00-0230
-12		Bottle Support Bracket	060-508-01
-13	84617052	Overflow Sensor	A3-05-1030
-14		Tubing Support, 1000/2000	060-314-02
		Tubing Support, 3000	063-314-01
-15	84617108	Tube, FEP (11,14), 1000/2000	060-317-00
-16	84617107	Tube, FEP (12,13), 1000/2000	060-316-00
-17	84617109	Tube, FEP (C), 1000/2000	060-318-00
-18		Tubing Support Cover, 1000/2000	06 5-02
		Tubing Support Cover, 3000	063-315-00
-19	84617025	Insert, Stainless Steel Joint	D9-80-0201
-20	84617050	Gasket	060-323-00
-21	84617020	Elbow Union, Stainless Steel	A6-27-5040
-22	84617042	Resettable Thermal Cutout	A3-40-1200
-23	84617041	Fusible Thermal Cutout	A3-40-1170
-24	84617167	Line Coupling	060-332-02
-25	84617077	O-Ring	B3-00-0610
-26	84617111	Line Coupling	060-330-01
-27	84617159	Paraffin Tank, 1000	060-329-01
	84617168	Paraffin Tank, 2000	061-329-01
	84617209	Paraffin Tank, 3000	063-329-01
-28		Ferrule, Stainless Steel (part of item 29)	30-0190
-29	84617024	Ferrule, Stainless Steel	D9-80-0170
-30	84617246	Plug (No. 21)	A6-35-5010
-31	84617243	Tube, FEP (11), 3000	063-316-00
-32	84617244	Tube, FEP (12), 3000	063-317-00
-33	84617245	Tube, FEP (C), 3000	063-318-00
-34	84617245	Tube, FEP (13), 3000	063-318-00

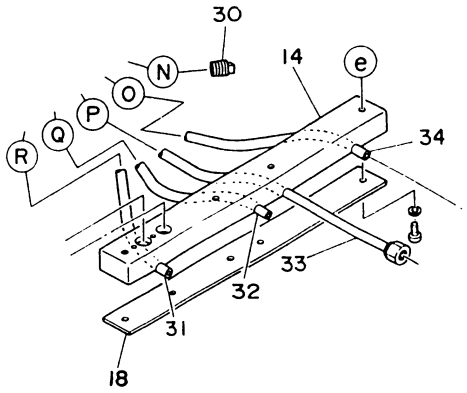


Figure 5-6b. Paraffin Tank Housing, V.I.P. 3000

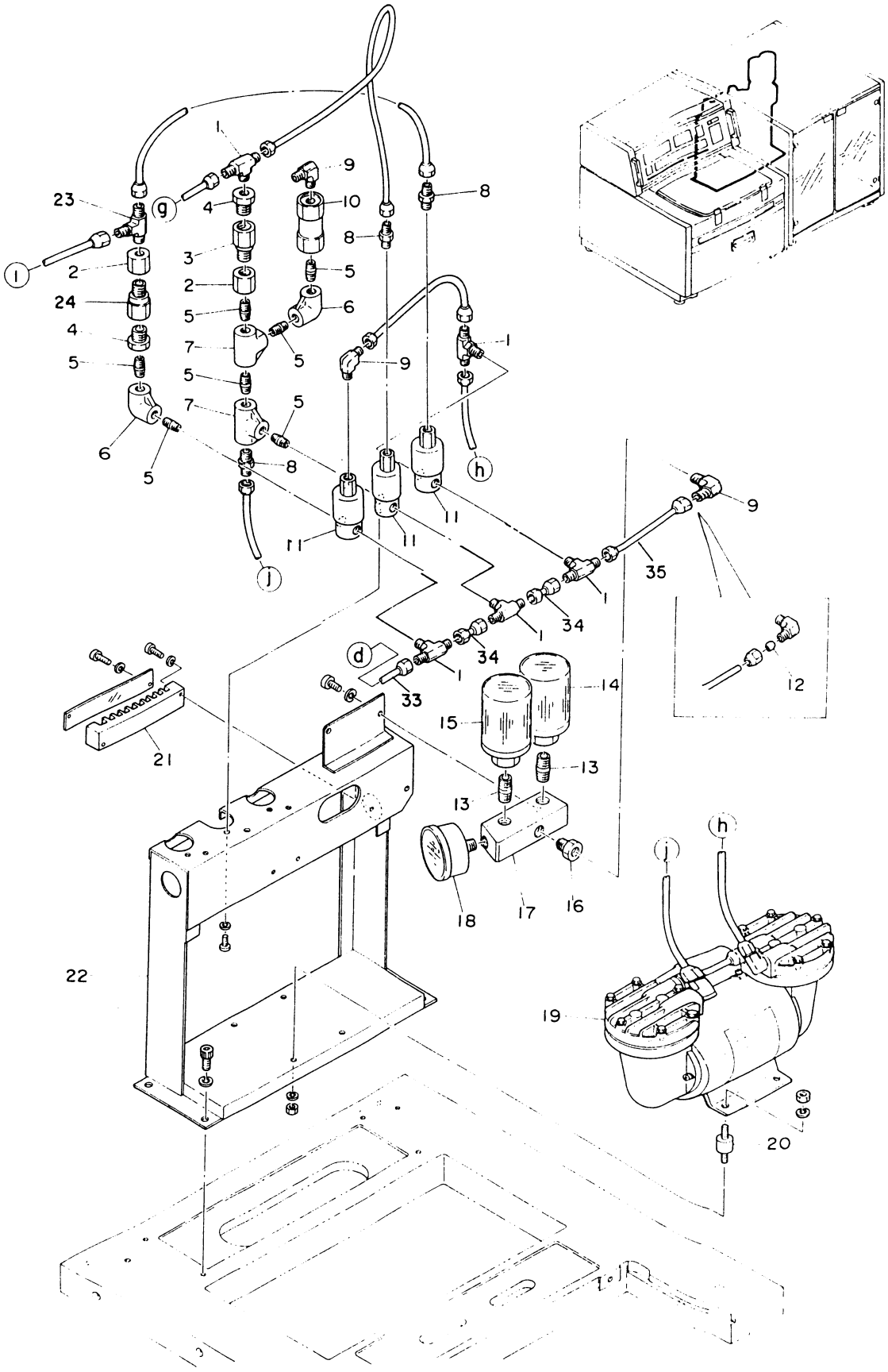


Figure 5-7a. Air Flow System, Exploded View, V.I.P. 1000/2000, Original Models

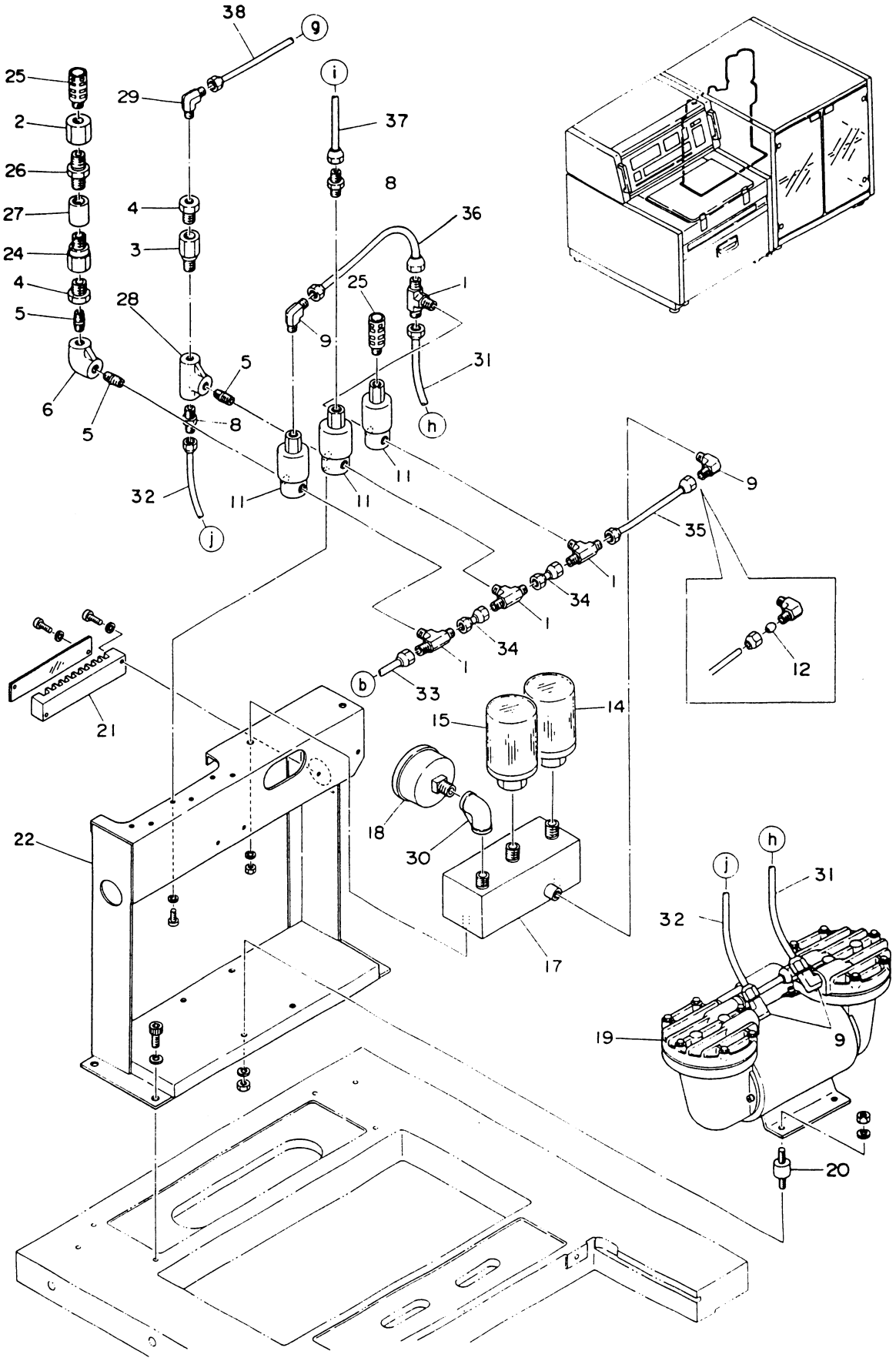


Figure 5-7b. Air Flow System, Exploded View, V.I.P. 1000/2000 Later Models

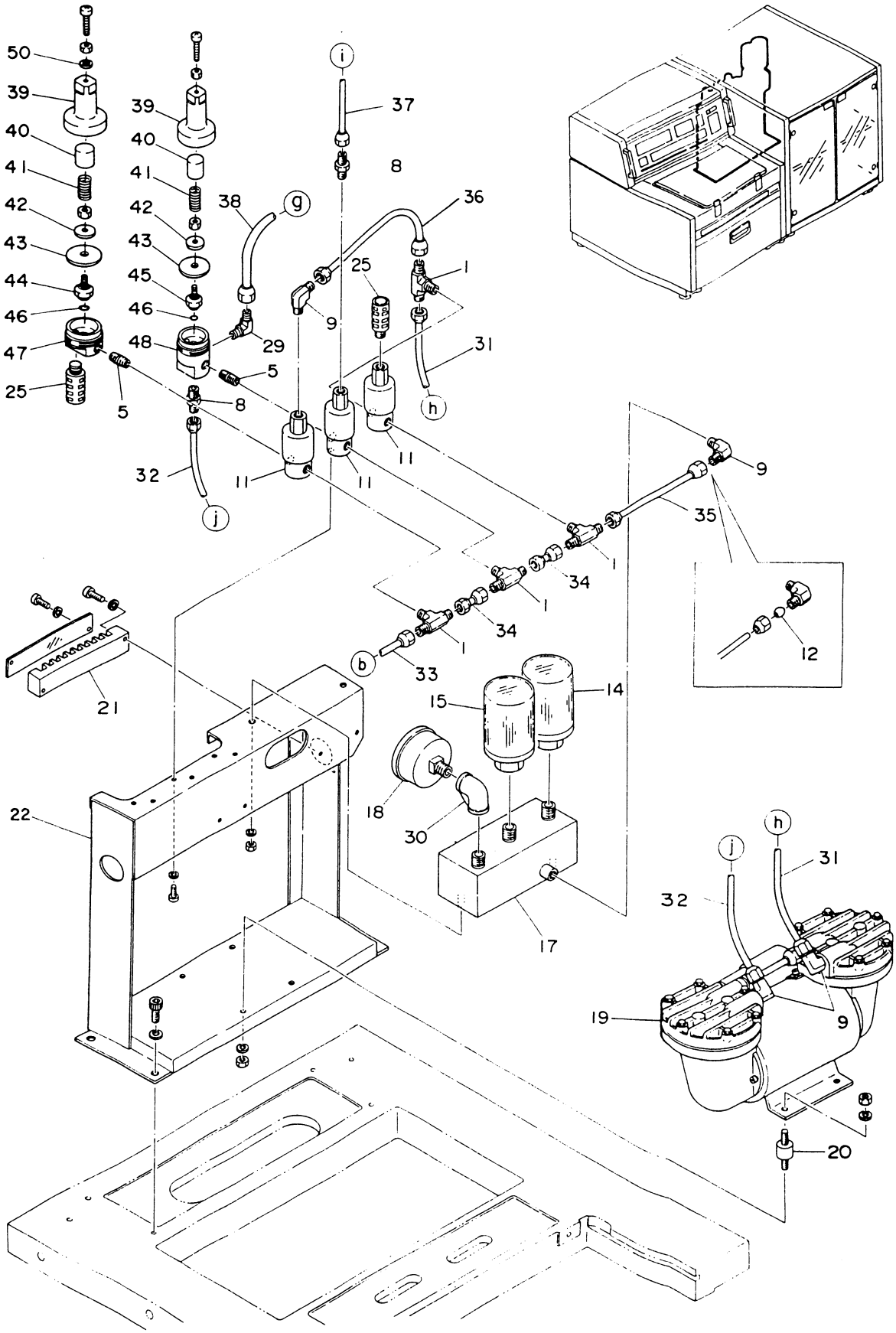


Figure 5-7c. Air Flow System, Exploded View, V.I.P. 1000/ 2000/3000 Latest Models

FIGURE & INDEX NUMBER	AMES P/N	DESCRIPTION	VENDOR P/N
5-7-1	84617070	Tee, P/A	A6-27-5130
-2	84617080	Conversion Coupling (B) S.S.	060-516-02
-3	84617058	Relief Valve, Pressure	A8-90-0060
-4	84617001	Conversion Coupling (A) S.S.	0[illegible]15-01
-5	84617064	Nipple, S.S.	A [illegible]-0010
-6	84617065	Elbow, S.S.	A6-31-0020
-7	84617066	Tee, S.S.	A6-32-0010
-8	84617068	Coupling, P/A	A6-27-5110
-9	84617069	Elbow, P/A	A6-27-5120
-10	84617169	Safety Valve	A8-00-7010
-11	84617060	Solenoid Operated Valve	A7-30-0190
-12	84617205	Ferrule, Plastic	09-80-0240
-13	84617071	Coupling, S.S.	A6-30-0020
-14	84617056	Pressure Sensing Switch	A5-20-0320
-15	84617057	Vacuum Sensing switch	A5-20-0330
-16	84617170	Restrictor & Filter	060-509-03
-17	84617172	Manifold, Nylon	060-501-01
	84617156	Manifold, Metal	060-501-02
-18	84617062	Pressure/Vacuum Gauge	B1-01-0180
-19	84617061	Pump	A9-02-0310
Not Shown	84617075	Reed Valve, Viton	D9-80-0230
Not Shown	84617074	Diaphragm, FEP Covered	D9-80-0220
-20	84617063	Anti-Vibration Mount	D9-03-0216
-21	84617027	Terminal Block	A4-05-0006
-22		Pump Frame	060-502-01
-23	84617021	Tee	A6-27-5160
-24	84617059	Relief Valve, Vacuum	A8-90-0070
-25	84617247	Filter	D9-80-4010
-29	84617039	Elbow	A6-27-5170
-30	84617248	Elbow	A6-31-0010
-31		Teflon Tube (f)	060-538-01
-32		Teflon Tube (e)	060-537-01
-33		Teflon Tube (b)	0[illegible]4-01
-34		Teflon Tube (g)	060-539-00
-35		Teflon Tube (h)	060-540-00
-36		Teflon Tube (c)	060-535-00
-37		Teflon Tube (a)	060-533-01
-38		Teflon Tube (d)	060-544-01
-39		Hood	060-546-01
-40		Spring Guide	060-553-00
-41		Spring	D9-28-0170
-42		Spacer	060-54[illegible]-00
-43		Pressure Diaphragm	060-547-01
-44		Valve (V)	060-550-01
-45		Valve (P)	060-549-01
-46		O-Ring	83-00-0720
-47		Regulator Body (V)	060-552-01
-48		Regulator Body (P)	060-551-01
-50		Screw with Rubber Washer	
Not Numbered	84617212	Vacuum Regulator Assembly	060-555-01
Not Numbered	84617211	Pressure Regulator Assembly	060-554-01
Not Numbered	84617200	Tubing, 8mm, 1 meter	B7-25-0010
Not Numbered	84617067	Tubing, 6mm, 1 meter	B7-25-0020

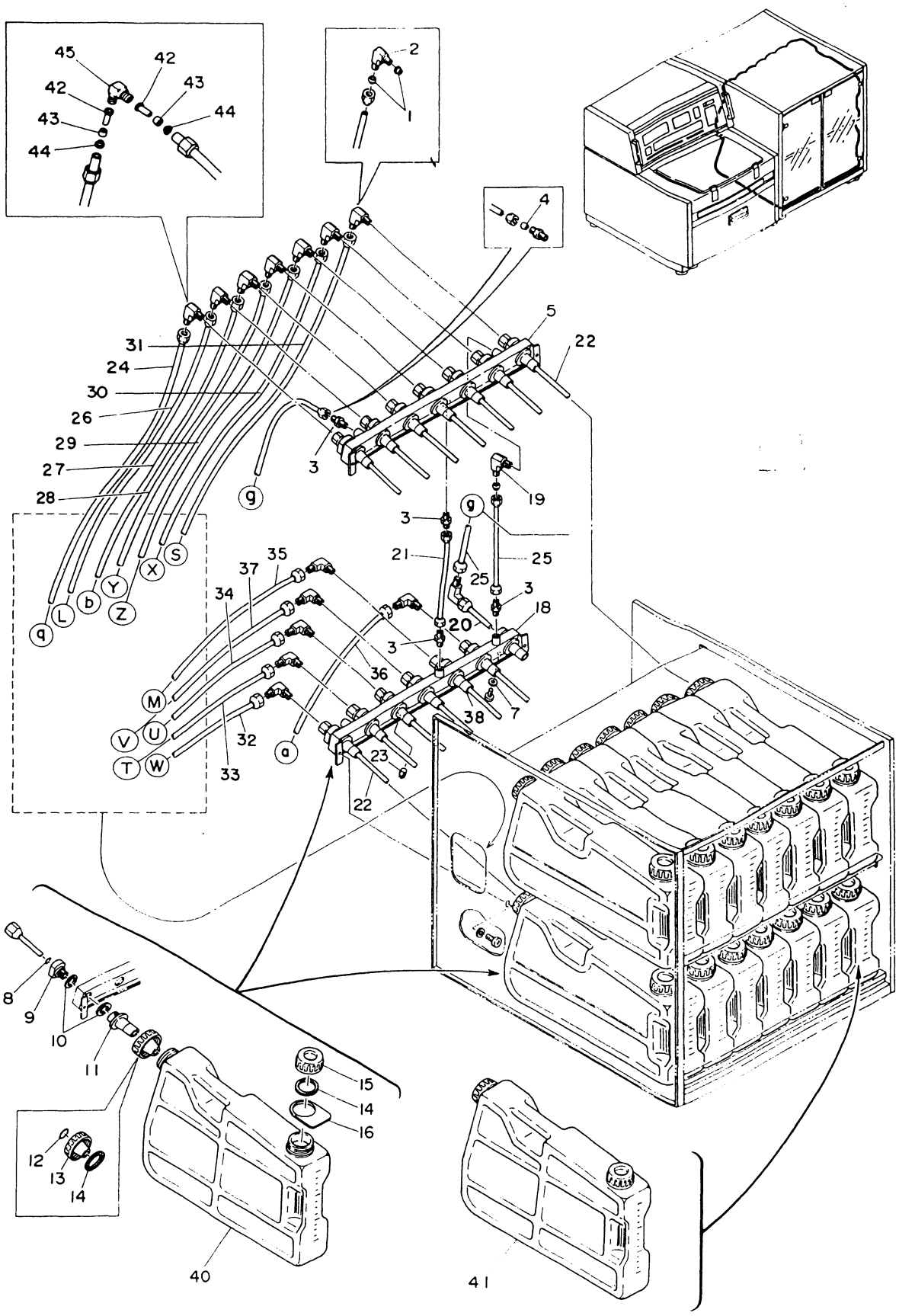


Figure 5-8. Reservoir System, Exploded View

FIGURE & INDEX NUMBER	AMES P/N	DESCRIPTION	VENDOR P/N
5-8-1	84617160	Ferrule, Plastic, 8mm	09-80-0250
-2	84617079	Elbow	A6-27-5150
-3	84617078	Coupling, P/A	A6-27-5140
-4	84617205	Ferrule, Plastic, 6mm	D9-80-0240
-5		Manifold, Upper	405-03
-7	84617175	Screw with Rubber Gasket	B3-03-0010
-8	84617077	O-Ring	B3-00-0610
-9	84617143	Sealing Nut	063-402-00
-10	84617113	Nozzle Gasket	060-403-01
-11	84617029	Nozzle, all except #16 (see 38 below)	060-401-02
-12	84617082	O-Ring, Cap	B3-00-0600
-13	84617115	Coupling Cap	060-409-04
-14	84617114	Cap Gasket	060-408-04
-15	84617142	Reservoir Cap	060-423-03
-16	84617135	Tag, Reservoir	060-908-01
-18	84617217	Manifold, Lower	060-404-04
-19	84617039	Elbow, P/A	A6-27-5170
-21		Exhaust Manifold Tube (A)	060-541-01
-22		Suction Port Tube (see 8mm tubing below)	060-424-01
-23	84617246	Plug (No. 21)	A6-35-5010
-24		Teflon Tube (1)	060-114-01
-25		Teflon Tube (B)	060-542-01
-26		Teflon Tube (2)	060-115-01
-27		Teflon Tube (3)	060-116-01
-28		Teflon Tube (4)	060-117-01
-29		Teflon Tube (5)	060-118-01
-30		Teflon Tube (6)	060-119-01
-31		Teflon Tube (7)	060-120-01
-32		Teflon Tube (8)	060-121-01
-33		Teflon Tube (9)	060-122-01
-34		Teflon Tube (10)	060-123-01
-35		Teflon Tube (16)	060-125-01
-36		Teflon Tube (c)	543-01
-37		Teflon Tube (15)	060-124-01
-38	84617257	Nozzle	060-428-00
-40	84617116	Solution Reservoir, 1000 or 2000	060-410-01
	84617207	Solution Reservoir, 3000	063-410-01
-41	84617176	Activated Carbon Reservoir	060-422-01
	84617208	Activated Carbon Reservoir	063-422-01
-42	84617025	Insert	D9-80-0201
-43	84617024	Ferrule	D9-8[illegible]70
-44		Ferrule (part of item 43)	D9-8[illegible]90
-45	84617258	L-Type Union	A6-34-0090
-46		Teflon Tube (E)	060-545-01
Not Numbered	84617200	Tubing, 8mm, 1 meter	B7-25-0010
Not Numbered	84617067	Tubing, 6mm, 1 meter	B7-25-0020

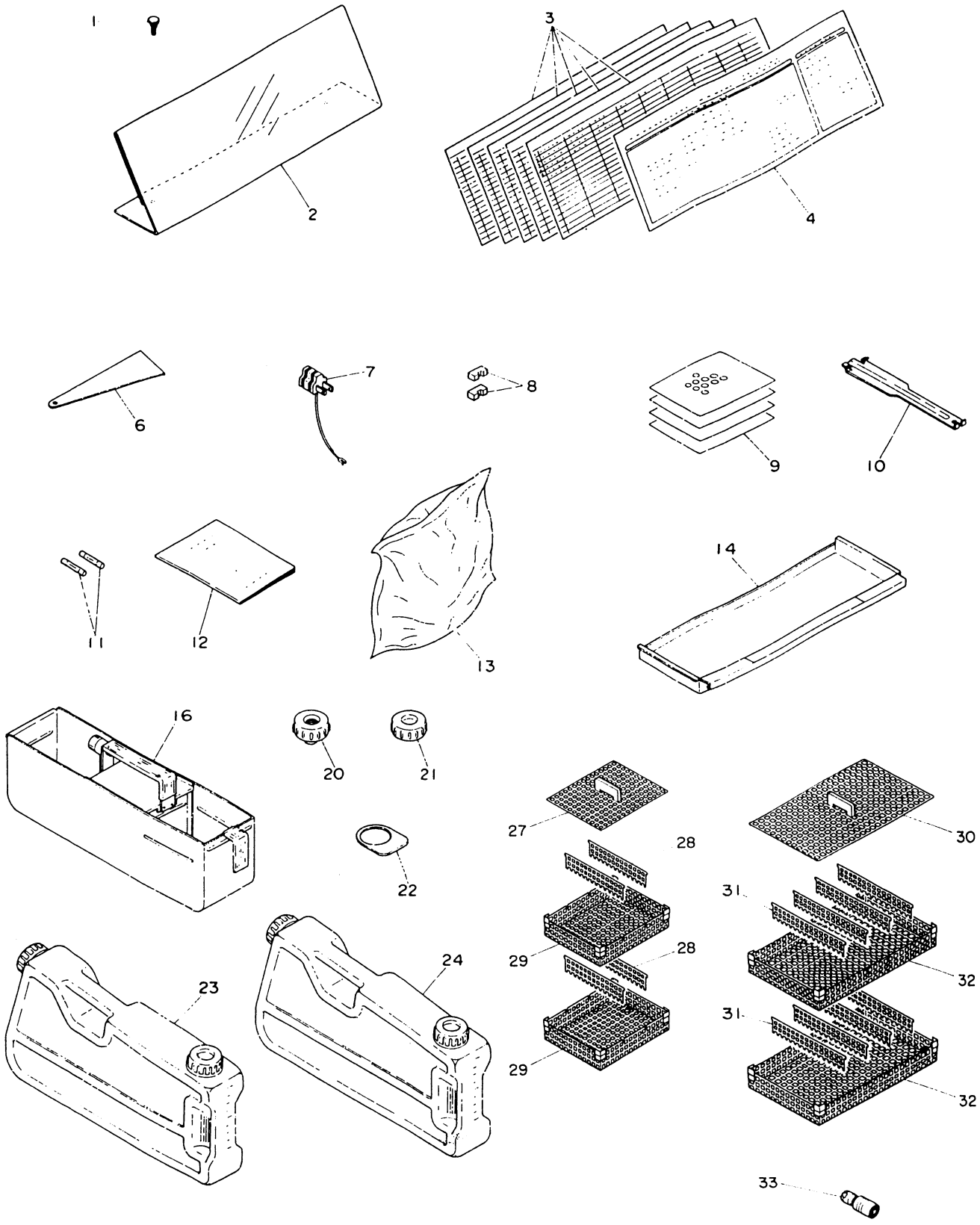


Figure 5-9. Miscellaneous Parts

FIGURE & INDEX NUMBER	AMES P/N	DESCRIPTION	VENDOR P/N
5-9-1	84617164	Screw	B5-10-0480
-2	84617177	Card Case	060-910-02
-3	84617144	Program Record Card	061-913-01
-4	84617178	Operating Guide	061-911-00
-6	84617146	Scraper	D[illegible]0800
-7		Grounding Adapter, 1000/2000	A4-02-0409
-8	84617092	Magnet	060-906-02
-9		Water Level Marker	D9-80-0090
-10	84617145	Carrier	060-905-02
-11	84617087	Fuse	A3-40-0370
-12	99946179	Operating Manual	
-13		Activated Carbon	D9-29-0270
-14	84617215	Spill Tray	060-334-00
-16	84617159	Paraffin Container, 1000	060-329-01
	84617209	Paraffin Container, 3000	063-329-01
-20	84617115	Coupling Cap	060-409-04
-21	84617142	Reservoir Filler Cap	060-423-03
-22	84617135	Tag	060-908-01
-23	84617116	Solution Reservoir, 1000/2000	060-410-01
	84617207	Solution Reservoir, 3000	063-410-01
-24	84617176	Activated Carbon Reservoir, 1000/2000	060-4[illegible]0
	84617208	Activated Carbon Reservoir, 3000	063-422-00
-27	84617130	Basket Lid, 1000 or 3000	061-902-03
-28	84617131	Divider, 1000 or 3000	061-903-03
-29	84617133	Basket, 4½ inch, 1000 or 3000	061-901-03
-30	84617171	Basket Lid, 2000	062-902-03
-31	84617173	Divider, 2000 or 3000	062-903-03
-32	84617174	Basket, 9½ inch, 2000 or 3000	062-901-03
-33	84617183	Plug, External Alarm	A4-06-0690

LIST OF HARDWARE

CODE NO.	NAME	Q'ty	TYPE/DIMENSIONS
	Hexagon Head Cap Screw		1B410BN3
	Hexagon Head Cap Screw		1B520FN3
8[illegible]7185	Hexagon Head Cap Screw		1B525S
8[illegible]7186	Hexagon Head Cap Screw		1B610S
	Hexagon Head Cap Screw		1B816FN3
	Hexagon Head Cap Screw		1B830FN3
84617187	Hexagon Socket Head Cap Screw		2B416
84617188	Hexagon Socket Head Cap Screw		2B610
84617189	Cross Pan Head Machine Screw with Spring Washer		3 x 6 BN3
84617190	Cross Pan Head Machine Screw with Spring Washer		4 x 8
84617191	Cross Pan Head Machine Screw with Spring Washer		4 x 10
84617192	Cross Pan Head Machine Screw with Spring Washer		5 x 12
	Cross Pan Head Machine with Spring Washer, Plain Washer		4 x 10
	Cross Pan Head Machine with Spring Washer, Plain Washer		4 x 15
	Cross Pan Head Machine Screw		3B38 BN3
	Cross Pan Head Machine Screw		3B38 FN3
	Cross Pan Head Machine Screw		3B316 BN3
	Cross Pan Head Machine Screw		3B320 BN3
	Cross Pan Head Machine Screw		3B412 BN3
84617196	Cross Pan Head Machine Screw		3B425 BN3
	Cross Pan Head Machine Screw		3B510 BN3
	Cross Pan Head Machine Screw		3B515 BN3
	Cross Flat Head Machine Screw		4B36 BN3
	Cross Flat Head Machine Screw		4B410 BN3
	Cross Round Flat Machine Screw		5B38 BN3
	Hexagon Nut		1N4BN3
84617193	Hexagon Nut		1N5BN3
	Hexagon Nut		1N8BN3
	Polished Round Washer		1W3BN3
	Polished Round Washer		1W4BN3
84617198	Polished Round Washer		1W8FN3
	Spring Washer		3W3BN3
	Spring Washer		3W4BN3
84617194	Spring Washer		3W5BN3
84617195	Spring Washer		3W6BN3
	Spring Washer		3W8BN3
[illegible]17197	Hexagon Socket Flat End Set Screw		1S48F

SECTION 6

DIAGRAMS

This section contains an interconnecting diagram for the processor and schematic diagrams for the circuits listed below.

P.C. Control Board	(CCU-1)	Fig 6-1
Front Panel P.C. Board	(CCU-3)	Fig 6-2
Position Sensor P.C. Board	(CCU-4)	Fig 6-3
Battery P.C. Board	(CCU-2)	Fig 6-4
Retort Interlock Detector P.C. Board	(CCU-5)	Fig 6-4
Interconnect Block Diagram		Fig 6-5
Terminal Wiring Diagram		Fig 6-6

ELECTRONIC PARTS
CONTROL BOARD (CCU-1)
FIGURE 6-1

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER
C1	Capacitor, Ceramic, 0.022mF, 50 V	
C2	Capacitor, Electrolytic, 220 mF	SM10VB-220BO
C3	Capacitor, Electrolytic, Tantulum, 3.3 mF	SSR25-3.3
C4	Capacitor, Ceramic, 100 pF, 50 V	
C5 through C7	Capacitor, Ceramic, 0.01 mF, 50 V	
C8, C9	Capacitor, Electrolytic, Tantalum, 10 mF	SSR25-10
C10	Capacitor, Electrolytic, Tantalum, 1 mF	SSR35-1
C11	Capacitor, Ceramic, 0.047 mF, 50 V	
C12 through C14	Capacitor, Polypropylene Film 0.15 mF	602M1003 154F
C15	Same as C5	
C16 through C18	Capacitor, Polypropylene Film, 1 mF	
C19 Not Used		
C20 through C22	Same as C10	
C23 through C29	Capacitor, Ceramic, 0.022 mF, 50 V	
C30	Capacitor, Electrolytic, Tantalum	SSR35-OR1
C31	Capacitor, Electrolytic, Tantalum, 3.3 mF	244M1602335M
32, C33	Capacitor, Electrolytic, 220 mF	SM10VB-220B0
C34 through C36	Same as C23	
C1-	Connector, 60 pin, (CCU-1 to CCU-3)	FCN-704 P060-Au/M
C2-	Connector, 10 pin (CCU-1 to CCU-4)	FCN-704 P010-Au/M
C3-	Connector, 4 pin (not used)	5045-04A
C4-	Connector, 3 pin (CCU-1 to CCU--5)	5045-03A
C5-	Connector, 2 pin (CCU-1 to Ext. A)	5281-2A
C6-	Connector, 3 pin (CCU-1 to Motor)	5281-3A
C7-	Connector, 7 pin (CCU-1 to Air Module)	5281-7A
C8-	Connector, 2 pin (CCU-1 to 100 Vac)	5281-2A
C9-	Connector, 2 pin (CCU-1 to O/F Sensor)	5281-2A
C10-	Connector, 8 pin, (CCU-1 to Heaters)	5281-8A
C11-	Connector, 2 pin, (CCU-1 to Thermistor)	5045-02A
C	Connector, 2 pin, (CCU-1 to Thermistor)	5045-02A
C1.-	Connector, 2 pin, (CCU-1 to Thermistor)	5045-02A
C14-	Connector, 4 pin, (CCU-1 to CCU--2)	5051-04
(Chip Decoupling)	Capacitor, Electrolytic, Tantalum, 3.3 mF	244M1602 335M
(Chip Decoupling)	Capacitor, Ceramic, 0.01 mF, 50 V	
CPU	Integrated Circuit, Z80-CPU	LH-0080
CTC	Integrated Circuit, Z80-CTC	LH-0082
D1	Diode	1S953
D2	Diode	0A95A
D3	Diode	1S953
4	LED, Green	GL-3PG1
D5 through D7	LED, Yellow	GL-3HY1
D8 through D11	LED, Red	GL-3PR1
D12 through D20	LED, Green	GL-3PG1
D21	Diode	1S953
D22 through D28	LED, Yellow	GL-3HY1
D29	Diode	1S953
IC1	Integrated Circuit, A/D Converter	ICL7109CPL
IC2	Integrated Circuit, Voltage Converter	ICL7660CPA
IC3	Integrated Circuit, Power Failure Detector	ICL8212CPA
IC4	Integrated Circuit, Battery Checker	ICL8212CPA
IC5	Integrated Circuit, 8-Bit I/O Port	MSL8212P
IC6	Integrated Circuit, TTL	74LS04
IC7	Integrated Circuit, TTL	74LS293
IC8	Integrated Circuit, TTL	74LS367
IC9	Integrated Circuit, TTL	74LS155
IC10	Integrated Circuit, TTL	74LS08
IC11	Integrated Circuit, TTL	74LS32
IC12	Integrated Circuit, TTL	74LS107
IC13	Integrated Circuit, TTL	74LS138
IC14	Integrated Circuit, TTL	74LS02
IC	Integrated Circuit, TTL	74LS02

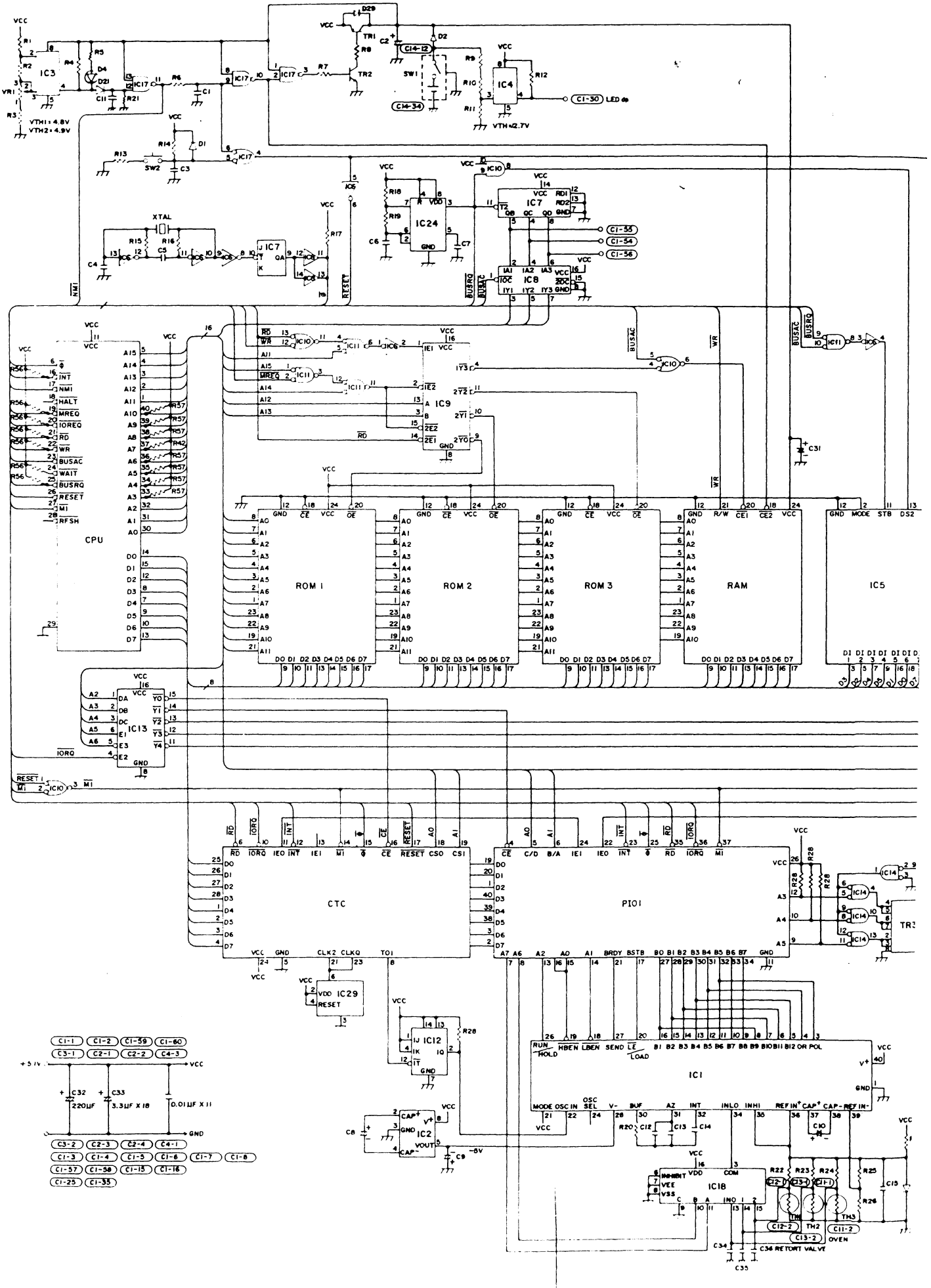
ELECTRONIC PARTS
CONTROL BOARD (CCU-1)
FIGURE 6-1 (CONT.)

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER
IC16	Integrated Circuit, TTL	74LS368
IC17	Integrated Circuit, C-MOS	MSM4093RS
IC18	Integrated Circuit, C-MOS	MSM4051RS
IC19	Integrated Circuit, C-MOS	MSM4025RS
IC20	Integrated Circuit, C-MOS	MSM4584RS
IC21	Same as IC20	
IC22	Same as IC20	
IC23	Same as IC20	
IC24	Oscillator, CR	MS1841P
IC29	Oscillator, Crystal	LQT-64X
JP1	Wire Jumper	
JP2	Same as JP1	
LI	Lithium Cell (3V)	BR1/2A-1P
PC1 through PC3	Photo Coupler	EE-CM4
PC4	Photo Coupler	EE-CM2
PC5	Photo Thyristor	TLP511G
PC6	Same as PC5	
PC7	Same as PC5	
PI01 through PI04	Integrated Circuit, Z80-PIO	LH-0081
R1	Resistor, Metal Film, 12K ± 1%	
R2	Resistor, Metal Film, 390 K ± 1%	
R3	Resistor, Metal Film, 100 K ± 1%	
R4	Resistor, Carbon Film, 1 K± 5%	
R5	Resistor, Carbon Film, 220± 5%	
R6	Resistor, Carbon Film, 100 K± 5%	
R7	Resistor, Carbon Film, 3.3 K± 5%	
R8	Resistor, Carbon film. 470± 5%	
R9	Resistor, Metal Film, 27 K ± 1%	
R10	Resistor, Metal Film, 100 K ± 1%	
R11	Resistor, Metal Film, 100 K ± 1%	
R12	Resistor, Carbon Film, 1 K± 5%	
R13	Resistor, Carbon Film, 100± 5%	
R14	Resistor, Carbon Film, 470 K± 5%	
R15	Resistor, Carbon Film, 820± 5%	
R16	Resistor, Carbon Film, 820± 5%	
R17	Resistor, Carbon Film, 120± 5%	
R18	Resistor, Carbon Film, 120 K± 5%	
R19	Resistor, Carbon Film, 1.5 K± 5%	
R20	Resistor, Metal Film, 22 K ± 1%	
R21	Resistor, Carbon Film, 2.2 M± 5%	
R22 through R26	Resistor, Metal Film, 1.8 K ± 1%	
R27	Resistor, Carbon Film, 220± 5%	
R28	Resistor, Network, 15 K (7) ± 5%	
R29 through R31	Resistor, Carbon Film, 680 ± 5%	
R32	Resistor, Carbon Film, 100 K± 5%	
R32*	Resistor, Carbon Film, 390 K± 5%	
R33	Resistor, Carbon Film, 100 K± 5%	
R33*	Resistor, Carbon Film, 390 K± 5%	
R34	Resistor, Carbon Film, 100 K± 5%	
R34*	Resistor, Carbon Film, 390 K± 5%	
R35	Resistor, Carbon Film, 39 K± 5%	
R35*	Resistor, Carbon Film, 220 K± 5%	
R36 through R41	Resistor, Carbon Film, 22 K± 5%	
R42	Resistor, Carbon Film, 15 K± 5%	
R46	Resistor, Carbon Film, 100 K± 5%	
R47	Resistor, Carbon Film, 4.7 K± 5%	
R48	Resistor, Metal Film, 5.6 K± 5%	
R49	Resistor, Metal Film, 10 K± 5%	
R50	Same as R49	
R51	Resistor, Carbon film, 220 K ± 5%	
R52	Resistor, Carbon film, 15 K ± 5%	

ELECTRONIC PARTS
CONTROL BOARD (CCU-1)
FIGURE 6-1 (CONT.)

REFERENCE ESIGNATION	DESCRIPTION	PART NUMBER
R53	Same as R52	
R56	Same as R28	
R57	Same as R28	
R58	Resistor, Carbon film, 15 K ± 5%	
R58*	Resistor, Carbon film, 330 K ± 5%	
R59	Resistor, Network, 100 (8) ± 5%	
R60	Resistor, Network, 47 K (5) ± 5%	
R60*	Resistor, Network, 82 K (5) ± 5%	
R61	Resistor, Network, 150 (8) ± 5%	
R62	Same as R28	
R63	Same as R61	
R64	Same as R61	
R65	Same as R28	
R66	Resistor, Network, 220 K (3) ± 5%	
R67	Same as R66	
R68	Same as R60	
R69	Resistor, Carbon film, 680 ± 5%	
ROM1	Integrated Circuit, EPROM	MBM2732A-35
ROM2	Same as ROM1	
ROM3	Same as ROM1	
RAM	Integrated Circuit, C-MOS RAM	TC5516AP
SK1 through SK3	Surge Absorber	NSKE-115
SR1	Solid State Relay, Valve, CCW	G3C-202P1
SR2	Solid State Relay, Valve, CW	Same as SR1
SR3	Solid State Relay, Pump	Same as SR1
SR4	Solid State Relay, Solenoid Valve 1	Same as SR1
SR5	Solid State Relay, Solenoid Valve 2	Same as SR1
SR6	Solid State Relay, Solenoid Valve 3	Same as SR1
SW1	Switch, Battery	M-2022P
V2	Switch, Reset	KHG 10905
.H1	Thermistor, Retort, B=3450 ± 2% (2.1837 K at 50° C)	PB-41E
TH2	Thermistor, Rotary Valve	Same as TH1
TH3	Thermistor, Oven	Same as TH1
TR1	Transistor	2SA1015
TR2	Transistor	2SC1815
TR3 through TR6	Transistor, Array	TD62104P
VR1	Resistor, Variable (Power failure detector adjust) 50 K	K-9W
X'tal	Oscillator, crystal	4.9152 MHz
Z1	Surge Absorber	ENB221D-10A
Z1*	Surge Absorber	ENB401D-10A
Z2	Same as Z1	
Z2*	Same as Z1*	
Z3	Same as Z1	
Z3*	Same as Z1*	
Z4	Same as Z1	
Z4*	Same as Z1*	
Z5 through Z7	Same as Z1	
	P.C.B., Battery (CCU-2)	060-703-01
	P.C.B., Control (CCU-1)	060-704-01

*designates 220/240 volt version.


CPU
ROM 1
ROM 2
ROM 3
RAM
IC5
CTC
PIO1
IC1
IC2
IC3
IC4
IC7
IC8
IC9
IC10
IC11
IC12
IC13
IC14
IC17
IC18
IC24
IC29
CPU
VTH1 : 4.8V
VTH2 : 4.9V
VTH=2.7V
LED dp
XTAL
RESET
NMI
BUSRQ
BUSAC
WR
RD
IORQ
M1
RFSH
INT
HALT
MREQ
WAIT
+5V
-8V
220μF
3.3μF X 18
0.01μF X 11
RETORT VALVE
OVEN

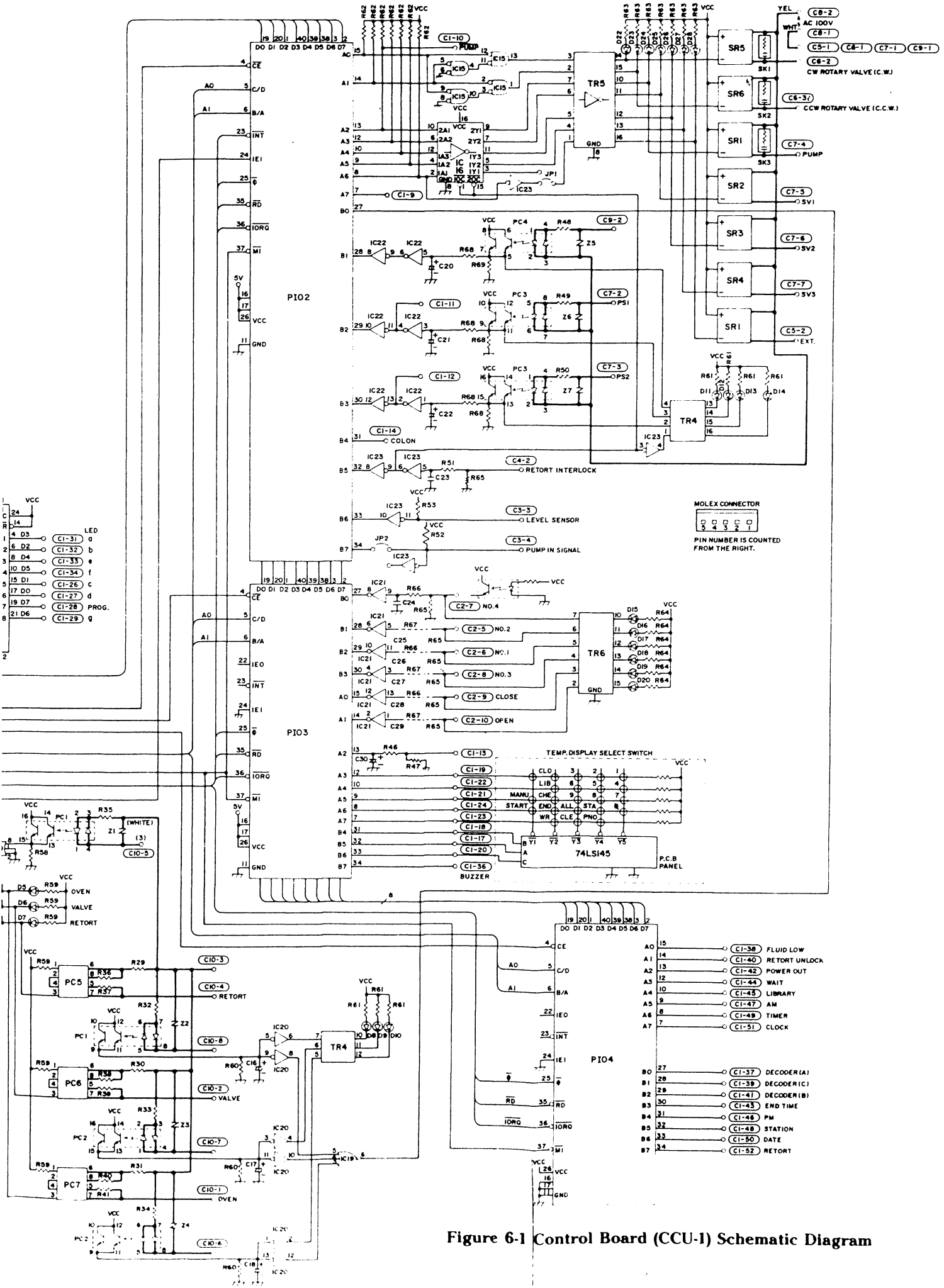
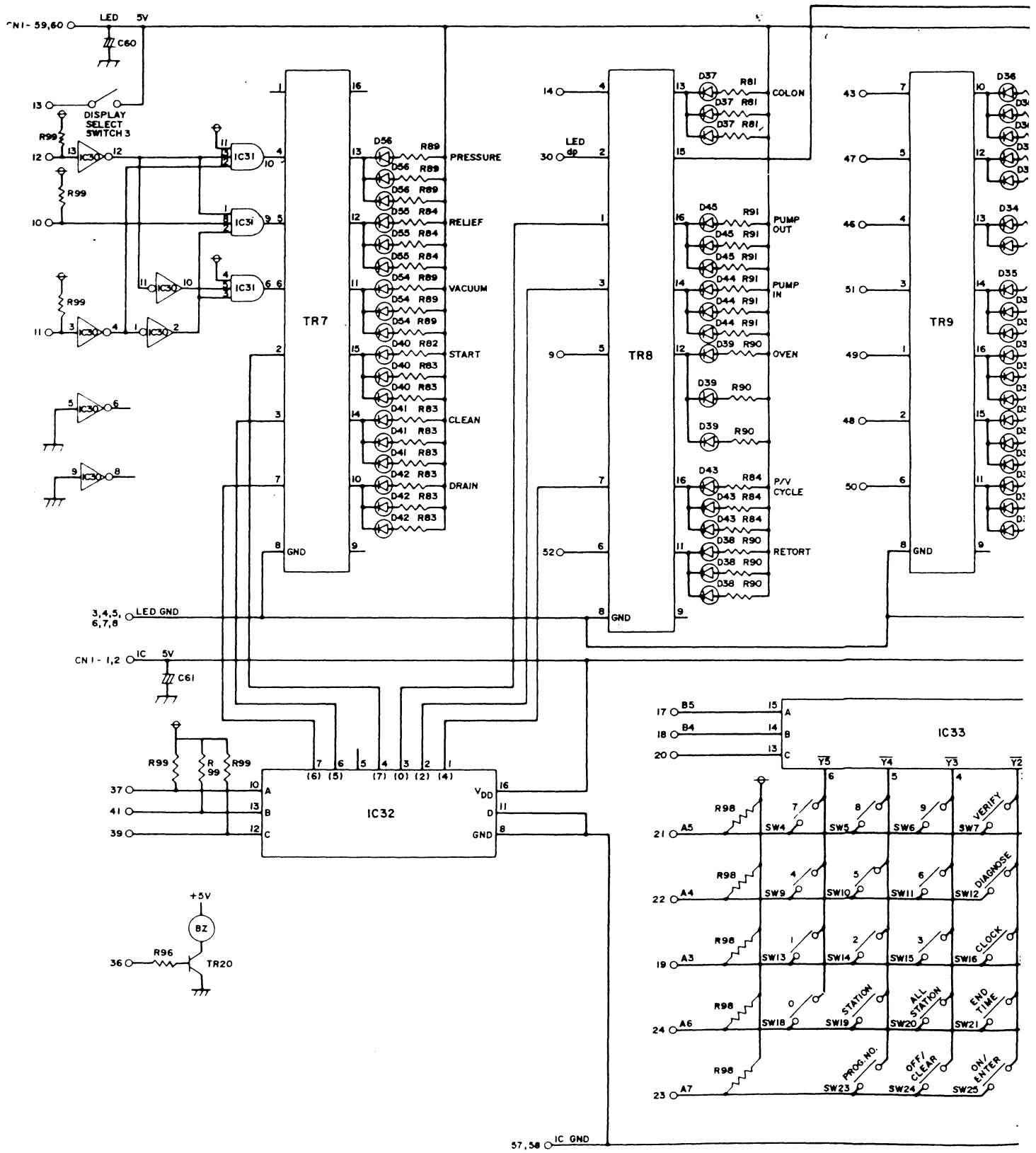


Figure 6-1 Control Board (CCU-1) Schematic Diagram

ELECTRONIC PARTS
DISPLAY AND PROGRAMMING BOARD (CCU-3)
FIGURE 6-2

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER
BZ	Buzzer	PB2625B01
C60	Capacitor, Electrolytic 47 mF	SM10VB-47BO
C61	Capacitor, Electrolytic Tantalum, 3.3 mF	ZZ4M1602 335M
C62	Capacitor, Ceramic, 0.01 mF, 50 V DC	
C63	Same as C60	
C64	Same as C61	
CN1	Connector	FCN754P060-40/3
D30, 31, 32	Diode, Light Emitting, Green	LT9010N
D33, 34	Diode, Light Emitting, Green	LT9002N
D35, 36	Same as D30	
D37	Diode, Light Emitting, Green	LT9010D
D38 through D43	Same as D30	
D44, 45	Diode, Light Emitting, Orange	LT9010H
D46 through D48	Diode, Light Emitting, Red	LT9010D
D49	Diode, Light Emitting, Red	LT9002D
D50	Same as D46	
D51	Same as D49	
D52, 53	Same as D46	
D54	Same as D44	
D55	Same as D30	
D56	Same as D44	
D57	Same as D30	
IC 30	Integrated Circuit, CMOS	MSM4584RS
IC 31	Integrated Circuit, CMOS	MSM4073RS
IC 32	Integrated Circuit, CMOS	MSM4028RS
IC 33	Integrated Circuit, TTL	74LS145
IC 34	Integrated Circuit, TTL	74LS138
LED1 through LED8	7-segment LED	TLR306
LED 9	7-segment LED	TLR308
R80 through R84	Resistor Network 100 ± 5%, 1/8W	RKC 1/8 B8
R85	Resistor Network, 150 ± 5%, 1/8W	RKC 1/8 B8
R86	Not Used	
R87 through R91	Same as R85	
R92	Resistor Network, 22 ± 5%, 1/8W	RKC 1/8 B4S
R93	Same as R92	
R94	Resistor Network, 1K ± 5%, 1/8W	RKC 1/8 B8
R95	Same as R94	
R96	Resistor, Carbon Film, 2.2 K ± 5%, 25W	RD25S
R97	Resistor, Carbon Film, 22 ± 5%, 25W	RD25S
R98	Resistor, Network, 4.7 K ± 5%, 1/8W	RKC1/8 B5S
R99	Resistor, Network, 15 K ± 5%, 1/8W	RKC 1/8 B7
R100, 101	Resistor, Carbon Film, 150 ± 5%, 25W	
SW3 through SW7	Switch, Pushbutton, Tactile	KHG10905
SW8	Switch, Reed	MSRR-2
SW9 through SW16	Same as SW3	
SW17	Same as SW8	
SW18 through SW25	Same as SW3	
TR7 through TR11	Transistor	TD62104P
TR12 through TR19	Transistor	25B605
TR20	Transistor	2SC1815


CN1-59,60
LED
5V
C60
DISPLAY SELECT SWITCH 3
R99
IC31
IC30
TR7
TR8
TR9
PRESSURE
RELIEF
VACUUM
START
CLEAN
DRAIN
COLON
PUMP OUT
PUMP IN
OVEN
P/V CYCLE
RETORT
LED dp
GND
3,4,5,6,7,8
LED GND
CN1-1,2
IC
C61
IC32
IC33
R98
SW4
SW5
SW6
SW7
VERIFY
SW9
SW10
SW11
SW12
DIAGNOSE
SW13
SW14
SW15
SW16
CLOCK
SW18
SW19
STATION
SW20
ALL STATION
SW21
END TIME
SW23
PROG.NO.
SW24
OFF/ CLEAR
SW25
ON/ ENTER
+5V
BZ
R96
TR20
57,58
IC GND

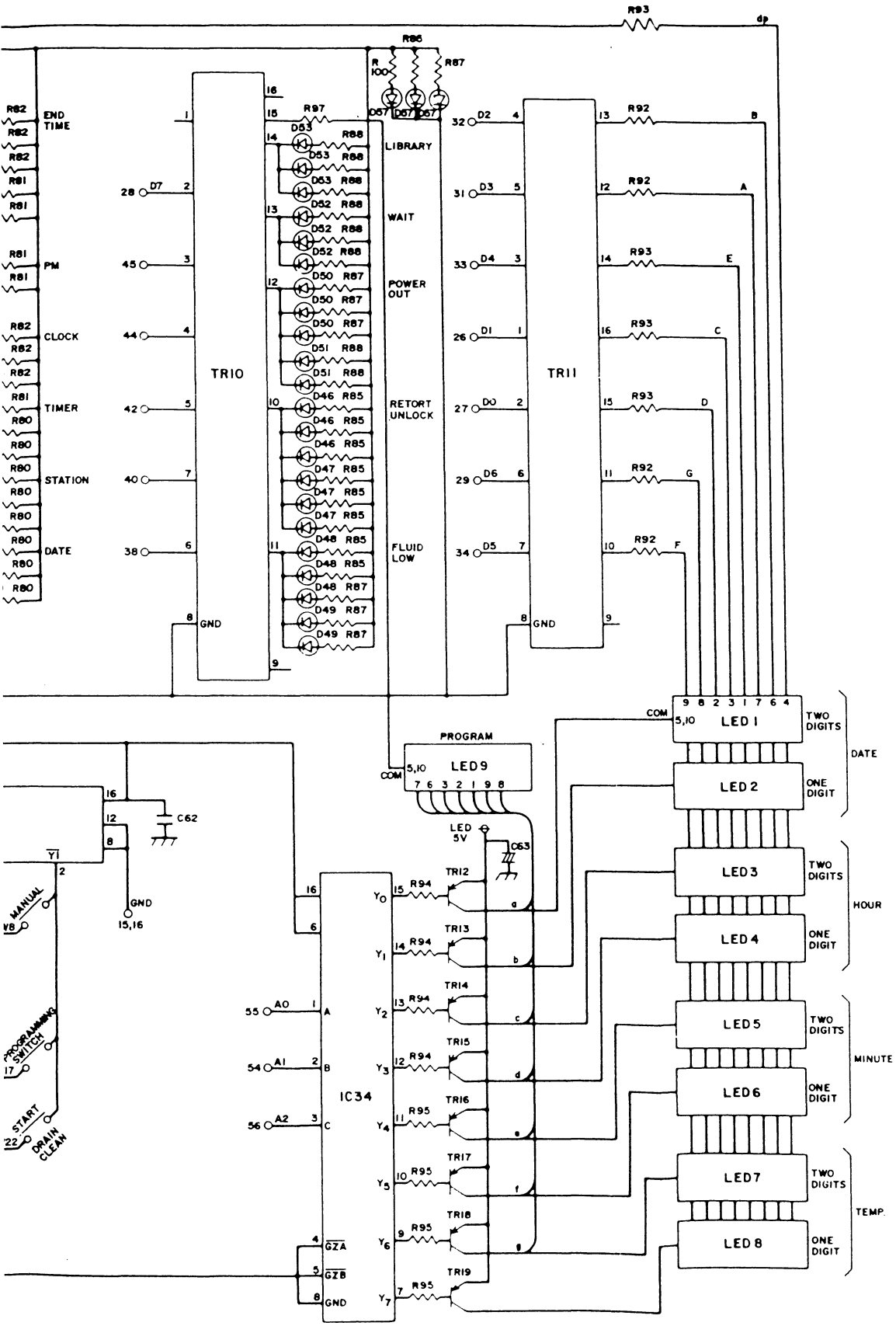
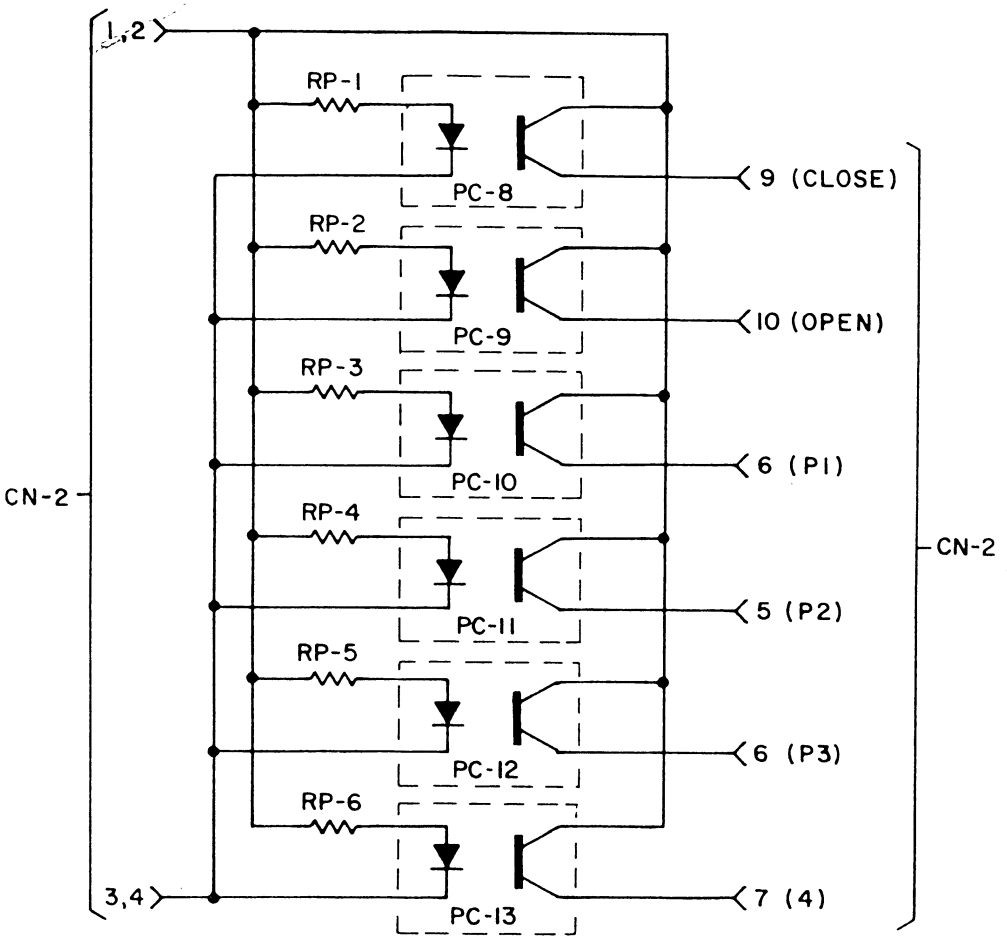
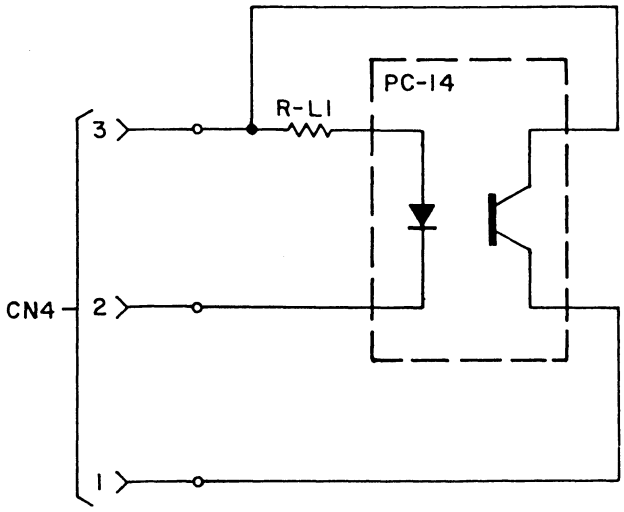


Figure 6-2 Front Panel Board (CCU-3) Schematic Diagram

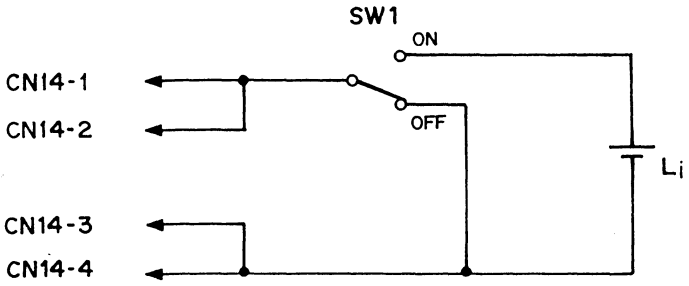


REF DESIG	DESCRIPTION	PART NO.
CN2	CONNECTOR	FCN-705P010-AU/M
R-P1 TO P6	RESISTOR 180Ω±5%	RD253
PC-8 TO 13	PHOTO COUPLER	EG-SJ3B

Figure 6-3 Position Sensor Board (CCU-4) Schematic Diagram



REF DESIG	DESCRIPTION	PART NO.
PC14	PHOTO COUPLER	EE-SJ3B
R-L1	RESISTOR 180Ω ± 1%	RD253
CN-4	CONNECTOR	5051-03



REF DESIG	DESCRIPTION	PART NO.
L1	BATTERY, LITHIUM	BP1/2A-1P
SW1	TOGGLE SWITCH	M-2022P
CN14	CONNECTOR	5045-04A

Figure 6-4 Battery Board (CCU-2) and Retort Interlock Detector (CCU-5) Schematic Diagram

ELECTRONIC PARTS
FIGURES 6-5 and 6-6

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER
C70	Capacitor	CH15
CCU-1	Control PCB	060-704-03
CCU-2	Battery PCB	060-703-01
CCU-3	Panel PCB	060-701-02
CCU-4	Rotary Valve Position PCB	A5-00-4750
CCU-5	Retort Interlock PCB	A5-00-4760
DC POWER	Regulator, Switching (5v D.C.)	ES-9-5
H-1	Heater, Retort Silicon Rubber, 120w/115v [120w/240v]	
H-2	Heater, Rotary Valve, 84w/115v [84w/240v]	
H-3	Heater, Oven Silicon Rubber, 120w/115v [120w/240v]	
H-4	Heater, O/F Tube (25w/m)	10PTV1-C [10PTV2-C]
L	Inductor	SN-M-105
M	Motor, Rotary Valve	4CSMGK-101
MR	Relay	LY-2
NF1	Noise Filter	ZMB22R5-11
NF2	Noise Filter	GTZ15U
NFB	Circuit Breaker, 15A, (G.F. 30MA)	NV-2FP15A (30MA)
OTP1,OTP2,OTP3	Fuse, Thermal (97°C)	B97-10A (97 ±5° C)
OTP4, OTP5, OTP6	Fuse, Thermal Manual Reset (80°C)	03-215035 (80° C)
P	Pump (100 v a.c., 72w)	AP-115AD
PS-1	Switch, Pressure Side	SPS-8TFPT 1/4
PS-2	Switch, Vacuum Side	SVS-1VPT 1/4
R120	Resistor, 400 ohms	
R121 to R124	Resistor, 5.6K ohms 3W	
SENSOR-1	Switch, Capacitance Proximity	E2K-C25MYI
SK4, SK5	Spark Killer	NSKE-115
SV1 to SV3	Solenoid Valve (100v a.c. 7w)	JB3316-PF-YTT0
T1	Transformer	TG-277D [TG-277-E]
TH-1 to TH-3	Thermistor, B=3450, (2.1837K ohms at 50°C)	PB-41E
TRC1 to TRC3	Triac	16A6DI

[ ] Indicates only for 220/240V A.C. Systems

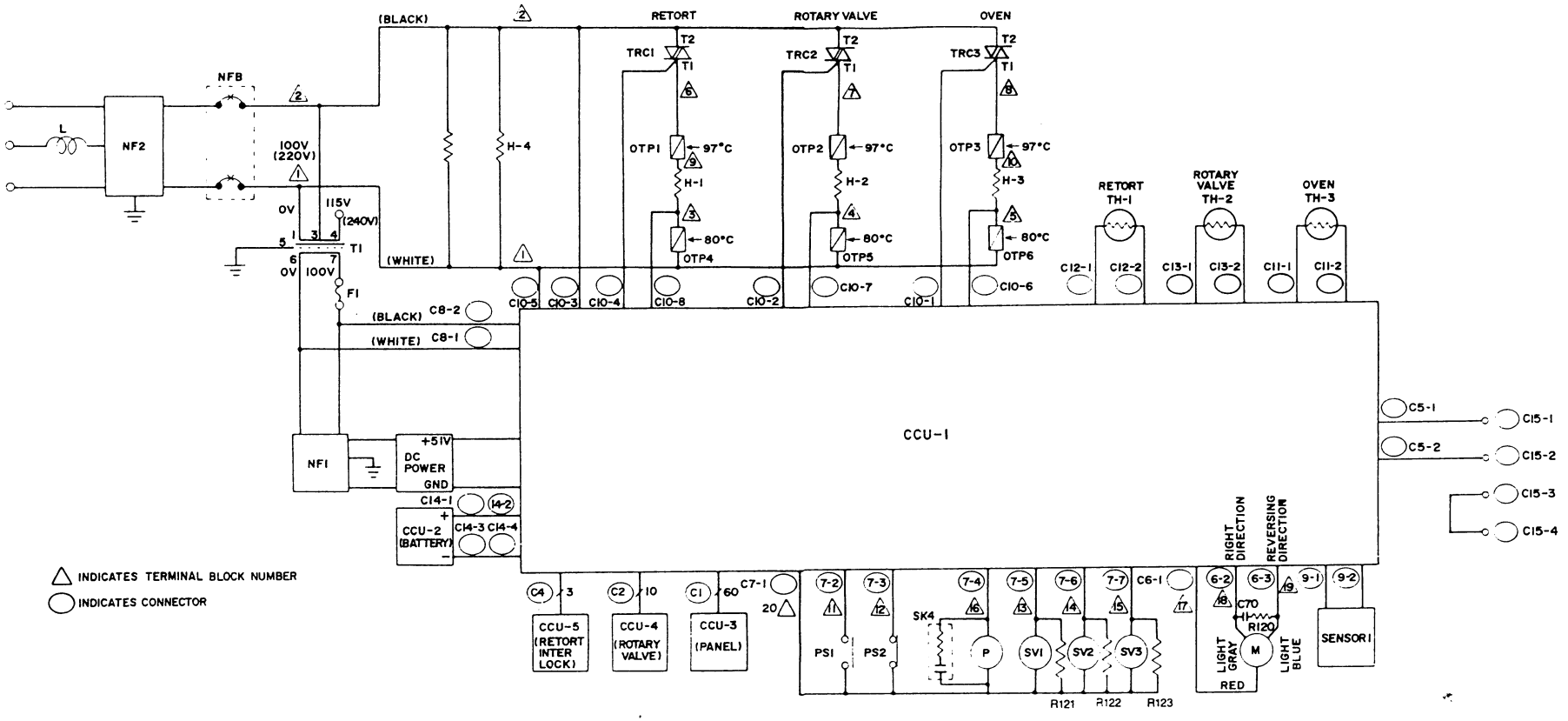
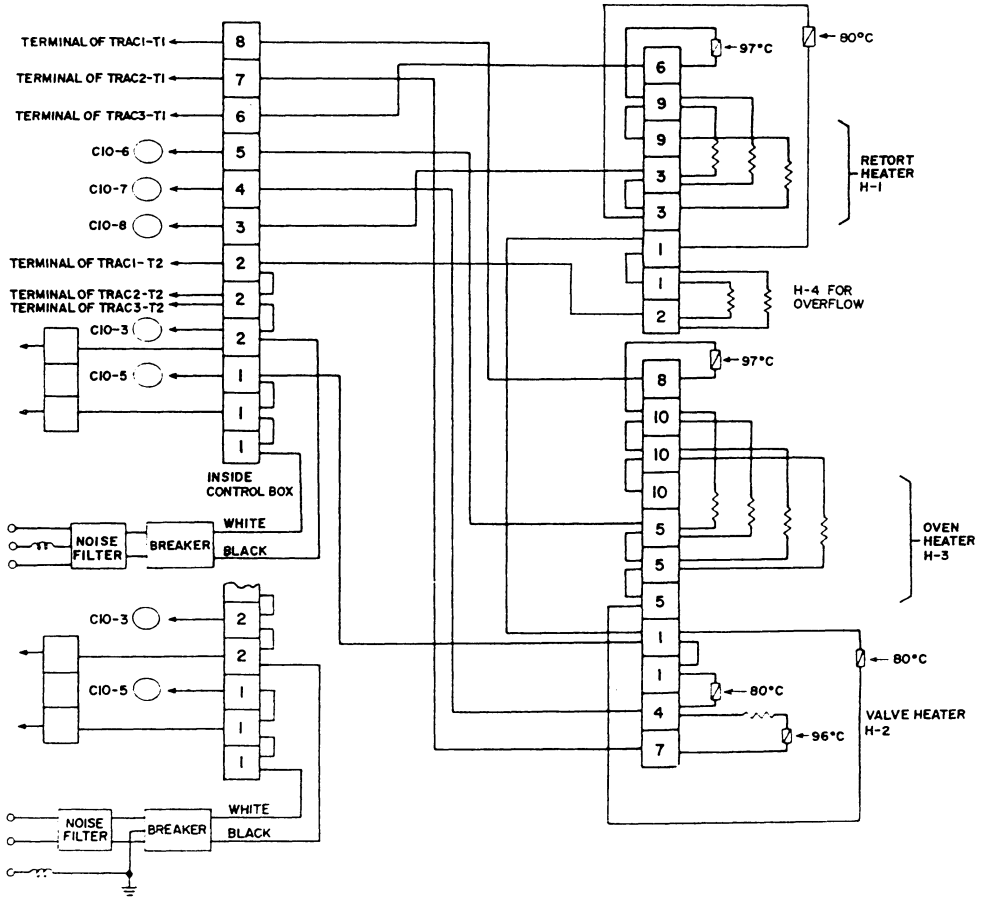
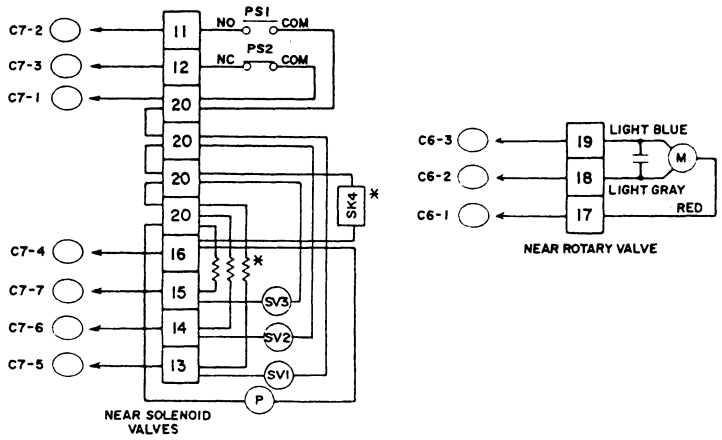


Figure 6-5 Interconnect Block Diagram



(TERMINAL BLOCK CONNECTION DIAGRAM)



*NOT IN OLDER UNITS
RESISTORS ARE RATED AT 5.6KΩ, 5W

Figure 6-6 Terminal Wiring Diagram

SECTION 7 SPECIFICATIONS

Power Requirements: 100/115V ±10%, 50/60 HZ, 13A
220/240V ±10% 50 Hz 6.5 A

Dimensions:
Counter Top Model 39½ in W, x 22½ in H x 23 in D
Floor Model 20 in W, x 47¼ in H x 23 in D

Maximum Operating Altitude: 8000 ft.

Ambient Operating Temperature: +10°C (50°F) to +40°C (104°F)

Solution Compatibility: Isopropanol, Ethanol, Xylene, Benzene, Toluene, Paraffin, Formalin Solution (0 to 20%), Water

Retort Capacity,
Model 1000: 100 Tissue-Tek II or III Cassettes
Model 2000: 200 Tissue-Tek II or III Cassettes
Model 3000: 300 Tissue-Tek II or III Cassettes

Number of Program Memories: 10

Alarms: Visible and Audible

Battery: National BR1/2A-1P (750m AH) 3.17 V. Lithium

Overload Protection: Resettable Circuit Breaker, 15A

Ground Leakage, 30mA max.

Overload Protection for Control Circuits: Fuses
(1) 115 V-3A
220 V-2A Type 3AG

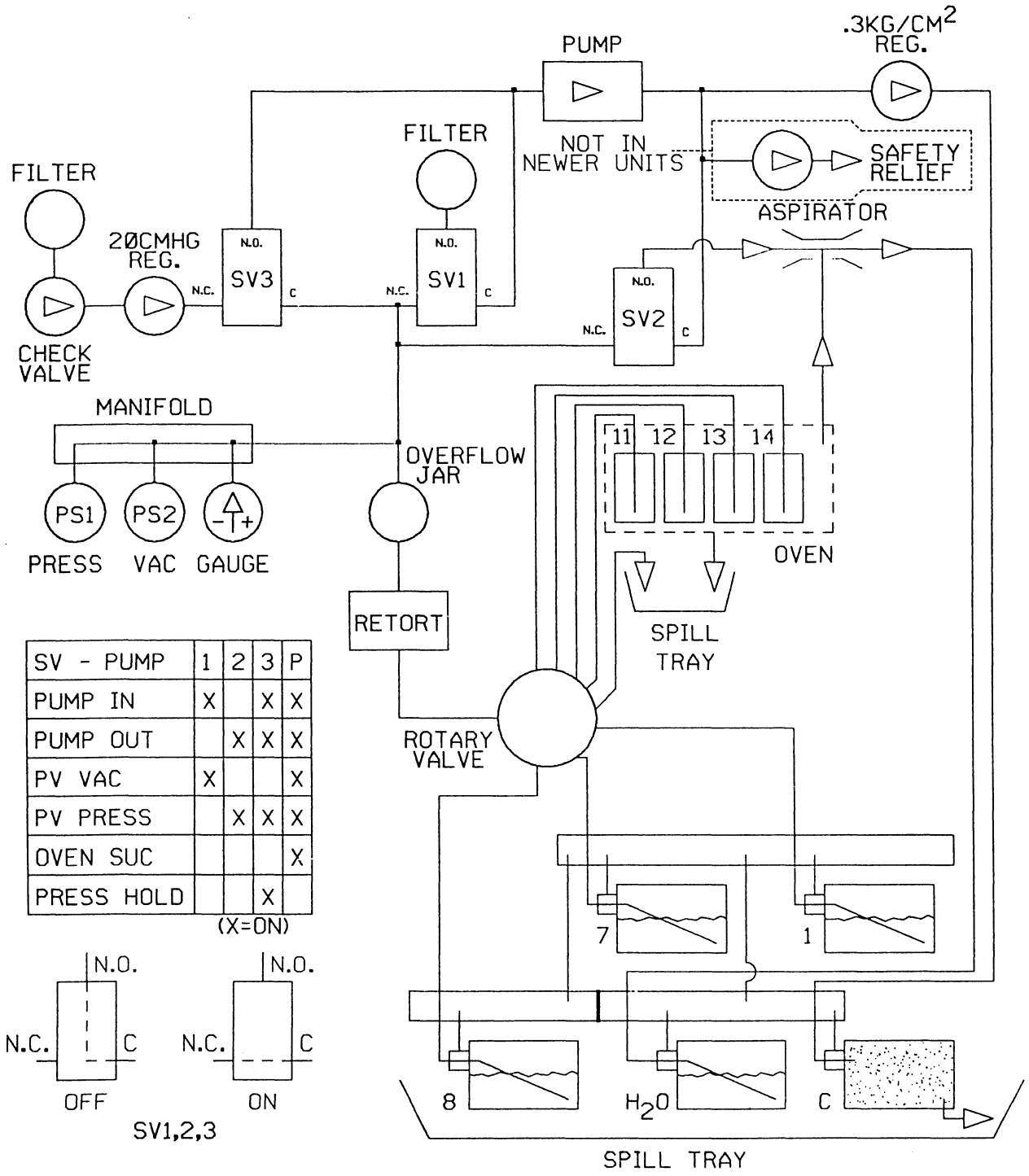
	VIP 1000	VIP 2000	VIP 3000
Solution Volume:	2 liters	2.8 liters	4.0 liters
Paraffin Volume:	2 liters	2.8 liters	4.0 liters
Cleaning Solution Volume:	2.8 liters	2.8 liters	4.0 liters
Water Filter:	2 liters	2 liters	2 liters
Activated Carbon:	1 kg	1 kg	1 kg

Temperature Display: 0°C to 99°C

Maximum Retort Operating Temperature: 70°C

Maximum Oven Operating Temperature: 73°C

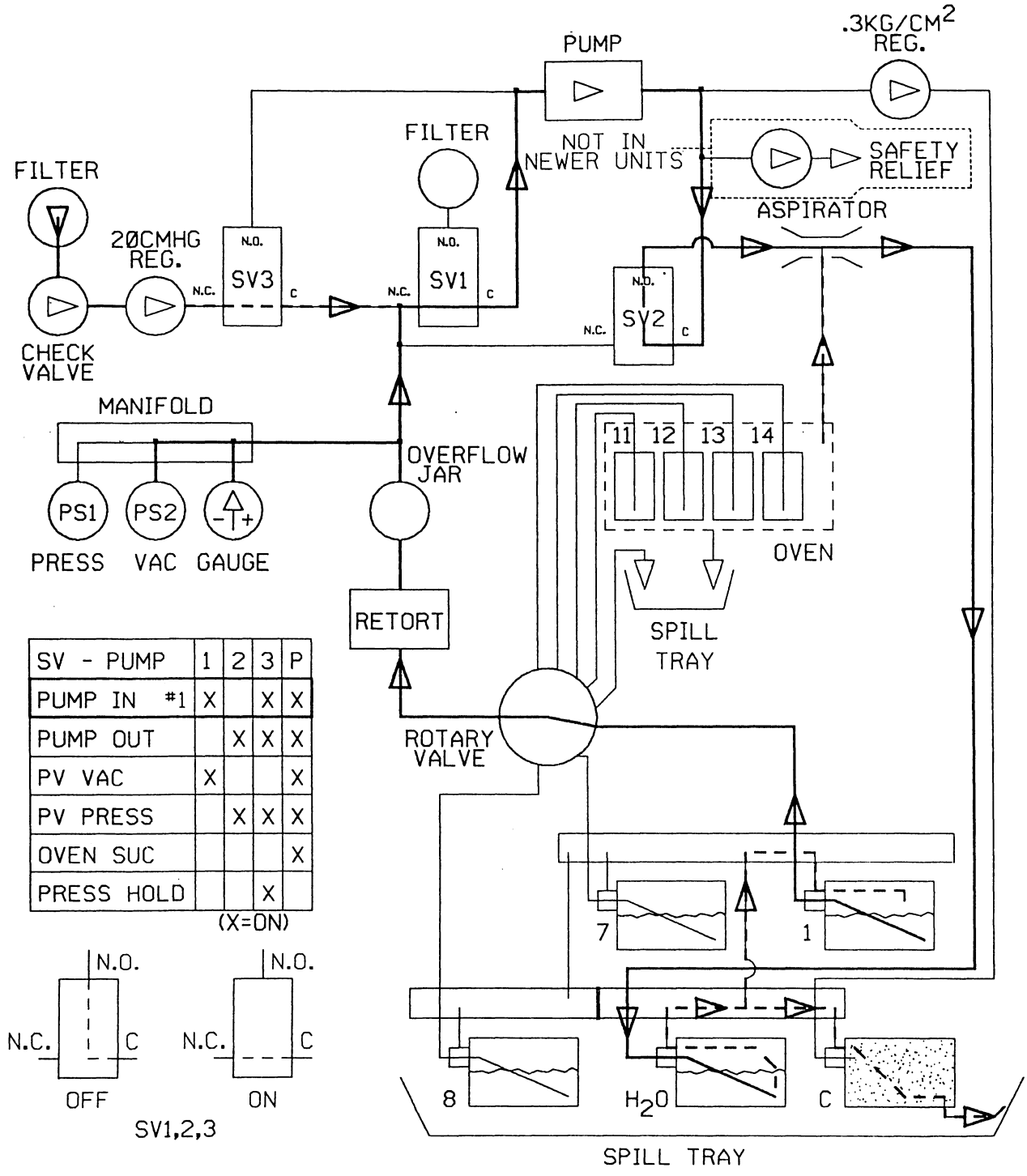
External Alarm: Electrically isolated relay contacts normally open. Five (5) minute delay before activation.



SV - PUMP	1	2	3	P
PUMP IN	X		X	X
PUMP OUT		X	X	X
PV VAC	X			X
PV PRESS		X	X	X
OVEN SUC				X
PRESS HOLD			X	

(X=ON)

Figure 8-1. General Fluid Flow Diagram



SV - PUMP	1	2	3	P
PUMP IN #1	X		X	X
PUMP OUT		X	X	X
PV VAC	X			X
PV PRESS		X	X	X
OVEN SUC				X
PRESS HOLD			X	

(X=ON)

Figure 8-2. Fluid Flow Diagram for Pump-In Operation

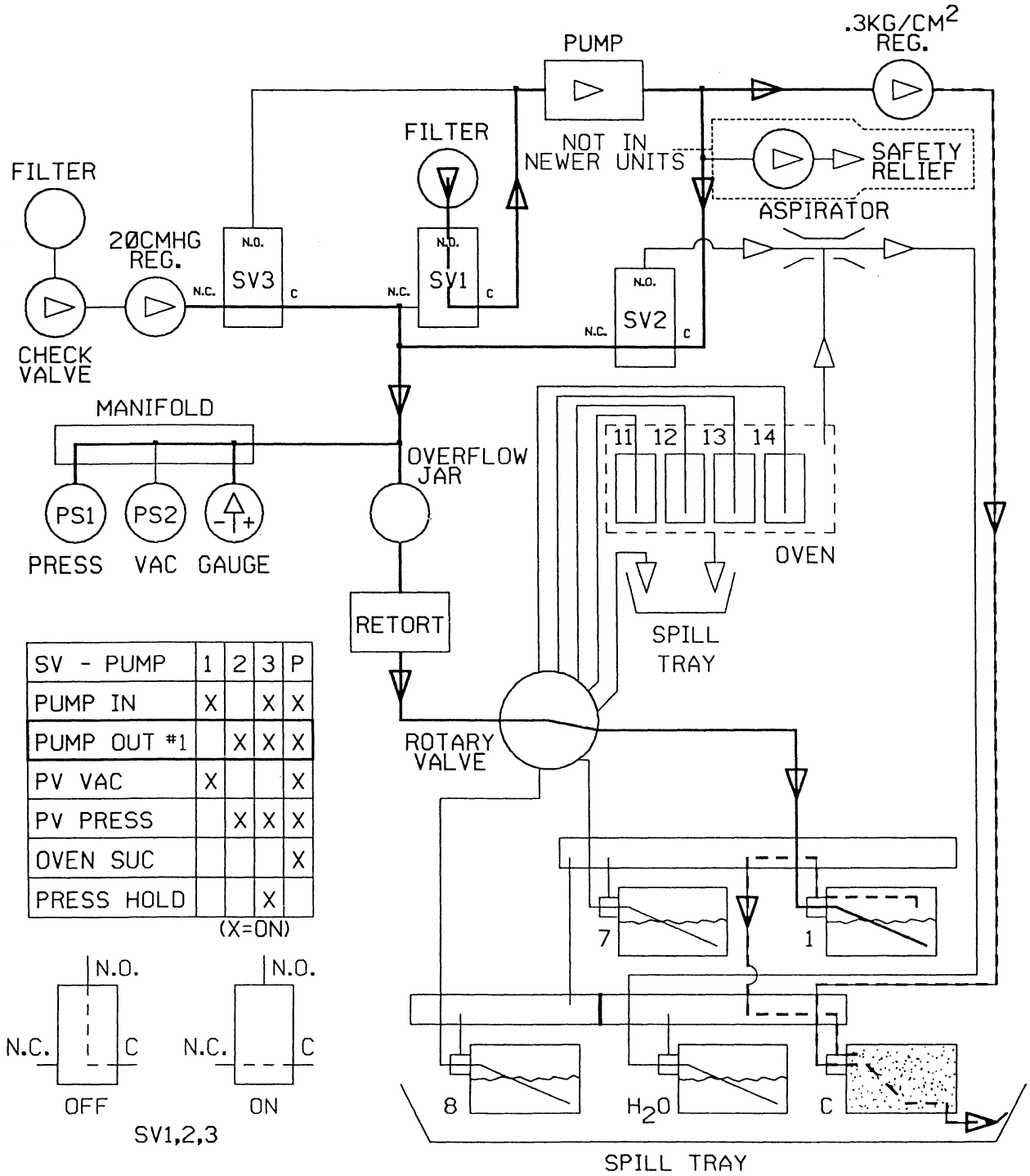


Figure 8-3. Fluid Flow Diagram for Pump-Out Operation

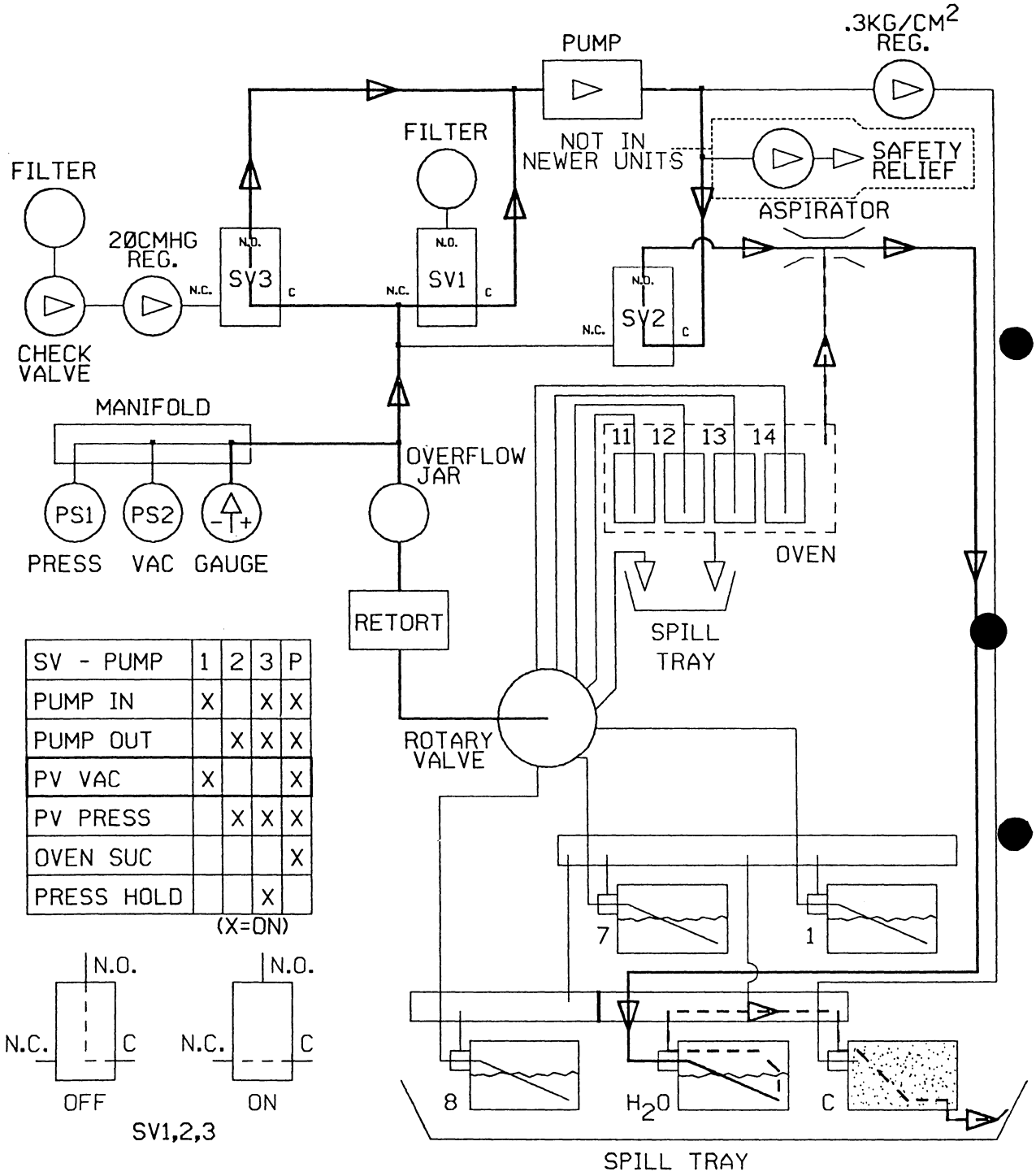


Figure 8-4. Fluid Flow Diagram for Vacuum Treatment

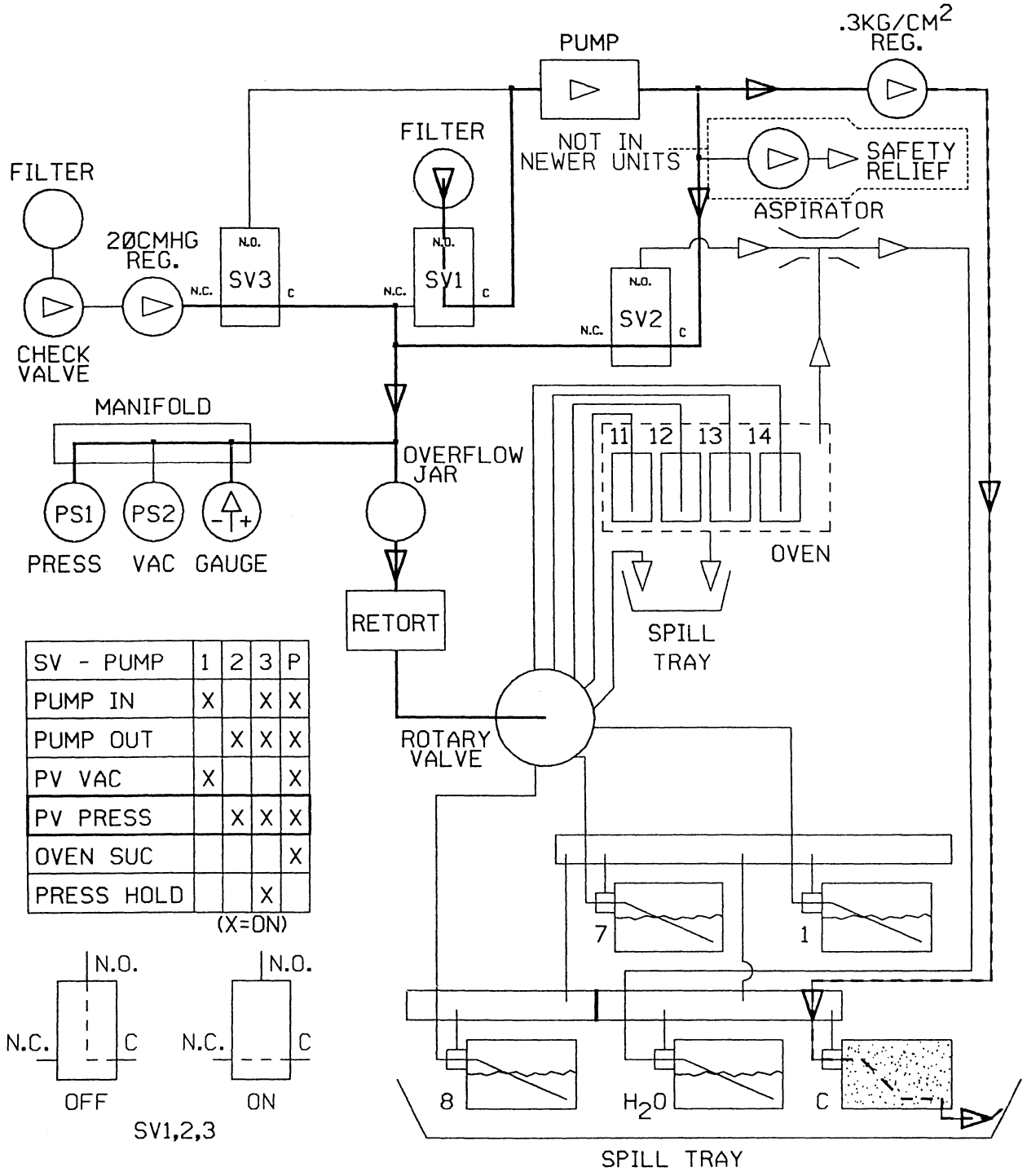


Figure 8-5. Fluid Flow Diagram for Pressure Treatment

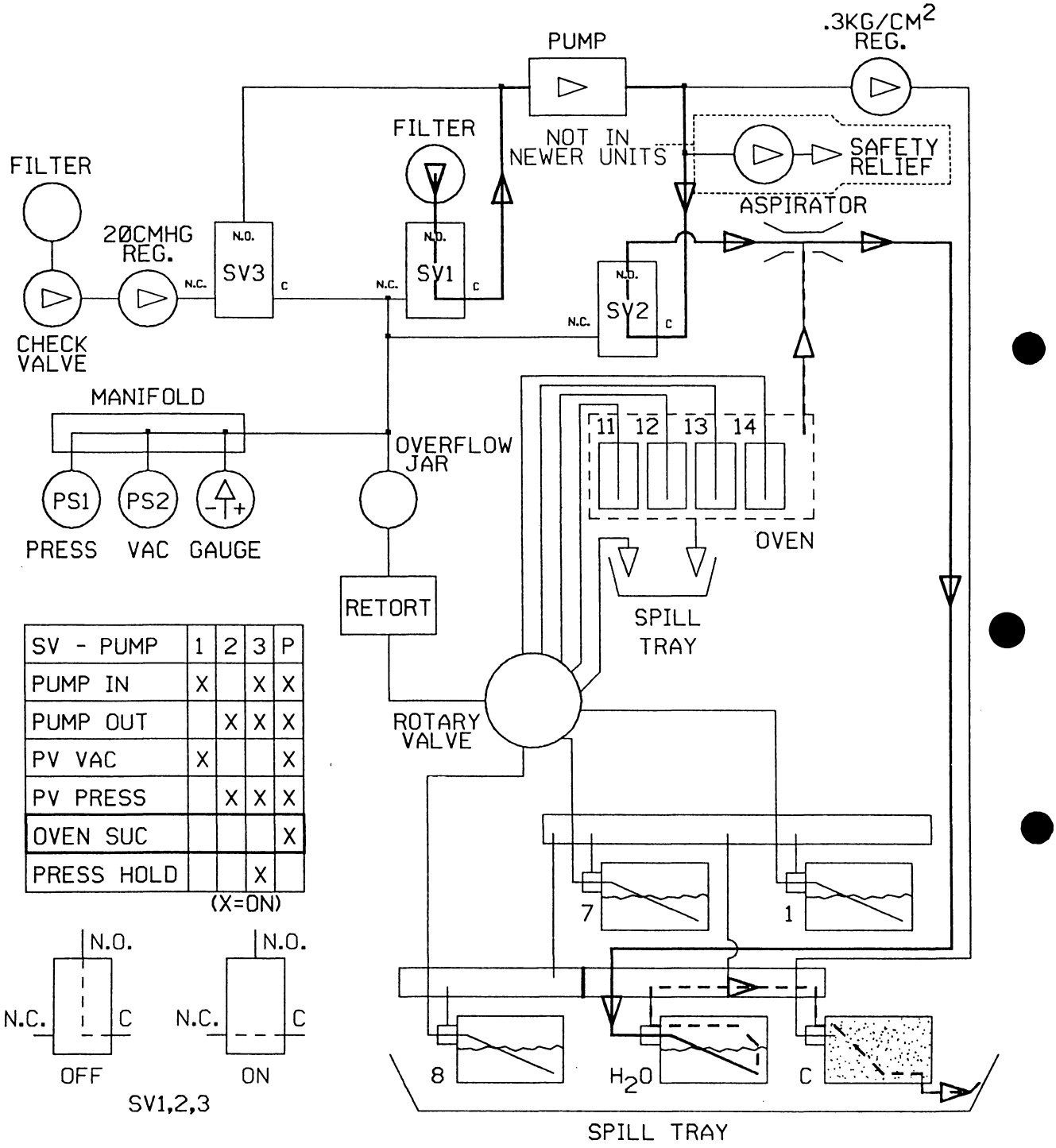


Figure 8-6. Fluid Flow Diagram for Oven Suction

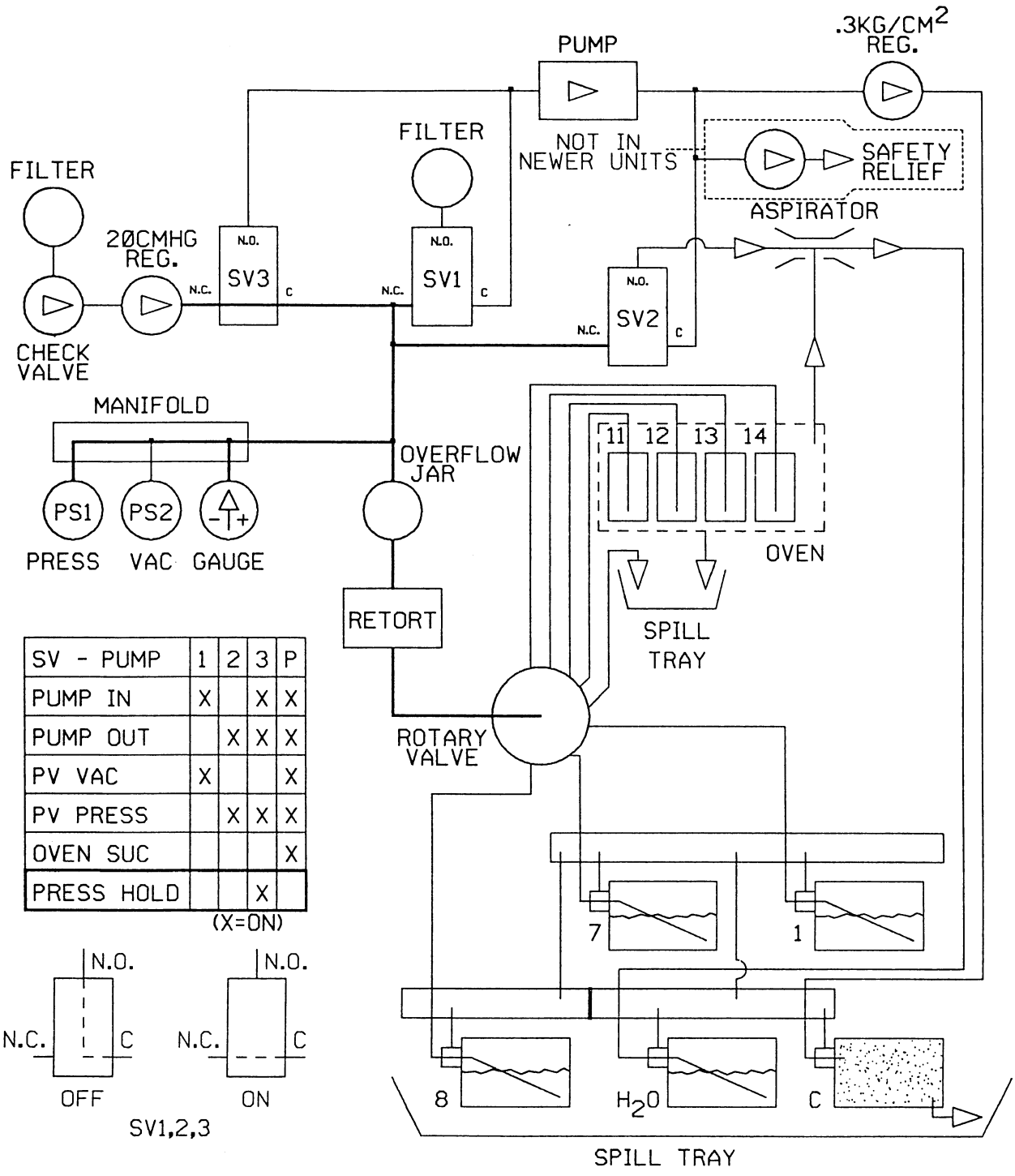


Figure 8-7. Fluid Flow Diagram for Pressure Hold

Townsville copy

VIP Tissue Processor

Service Information

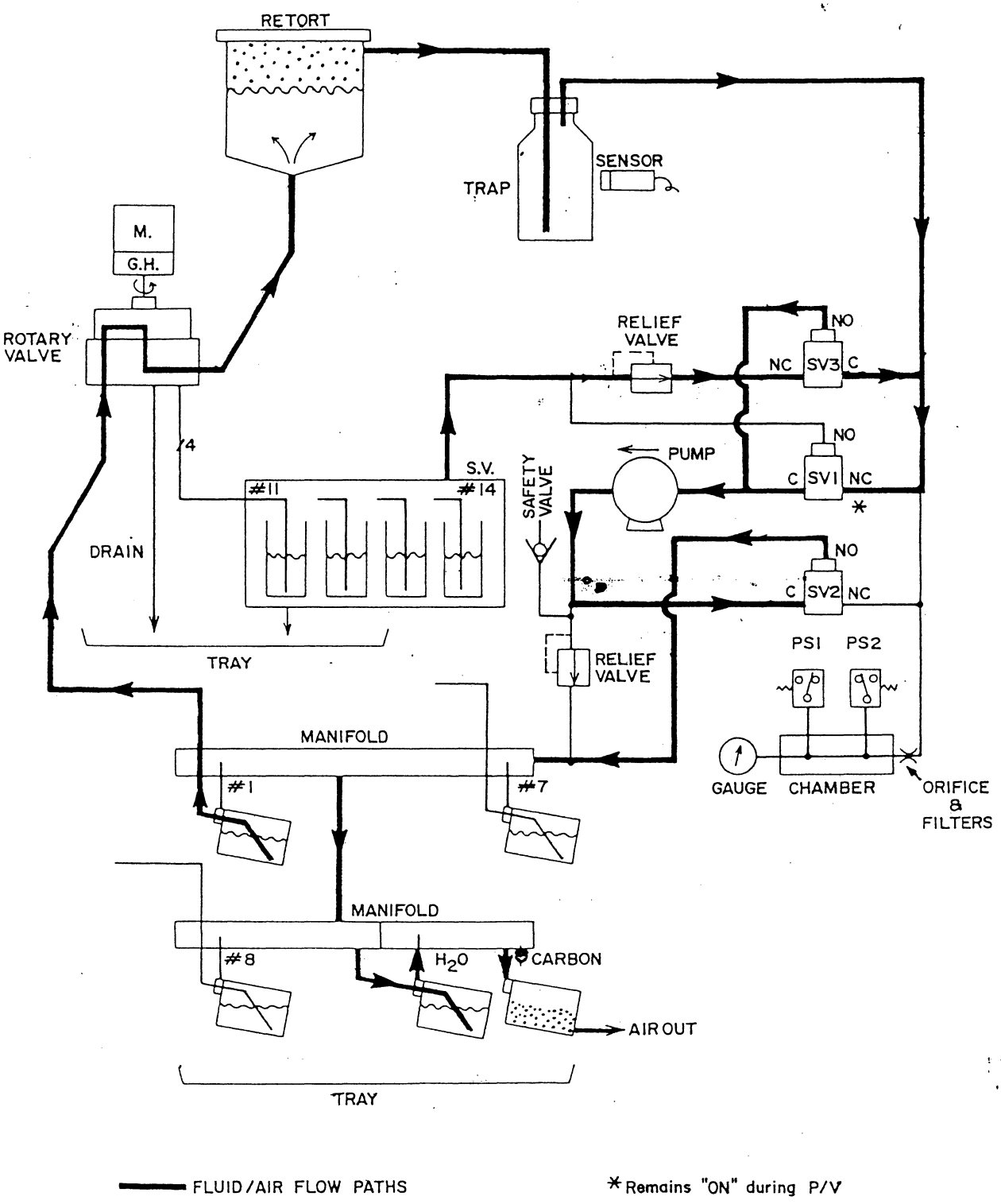


Figure 1-2. Air/Vacuum System Fluid Flow Diagram, Pump-In

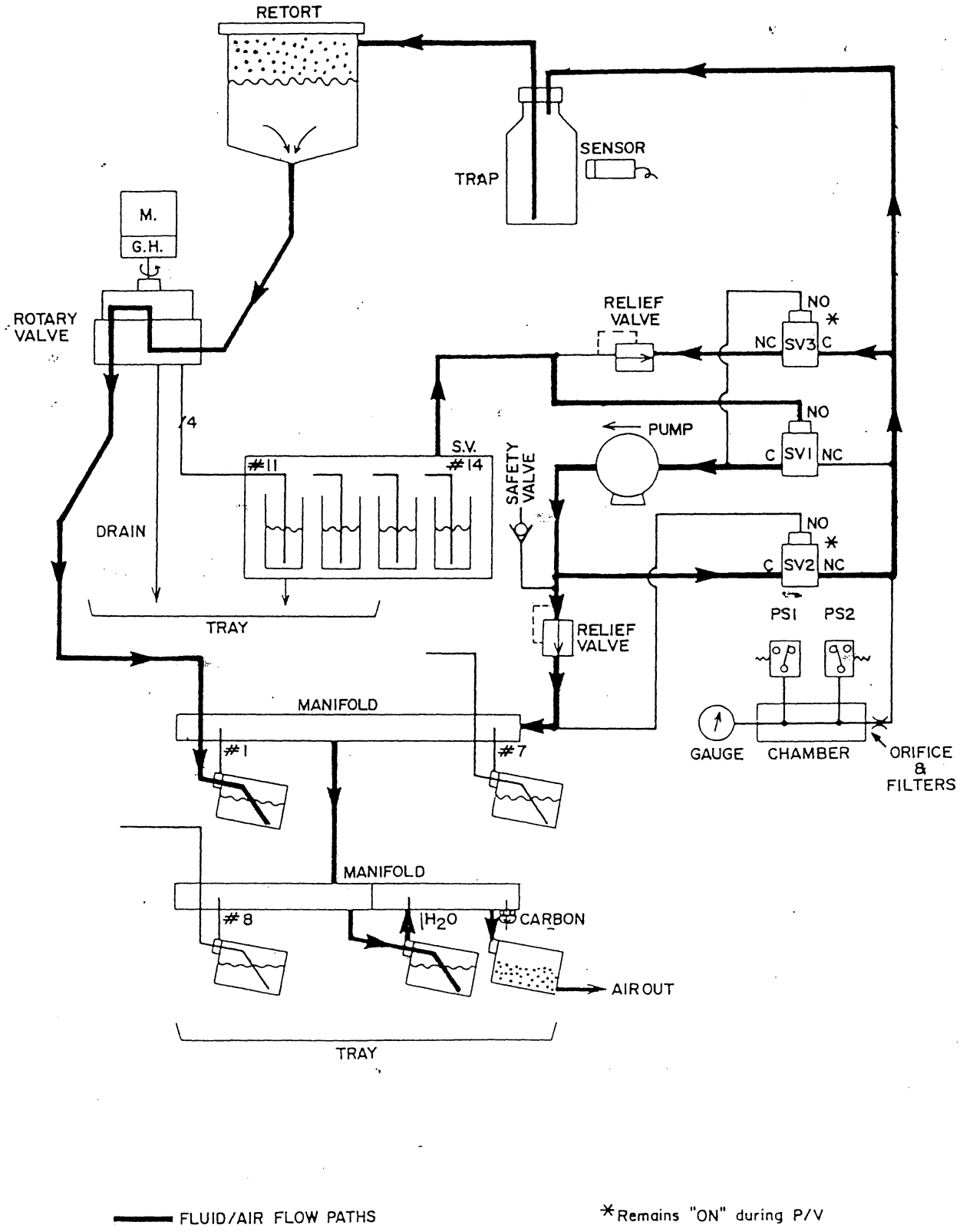
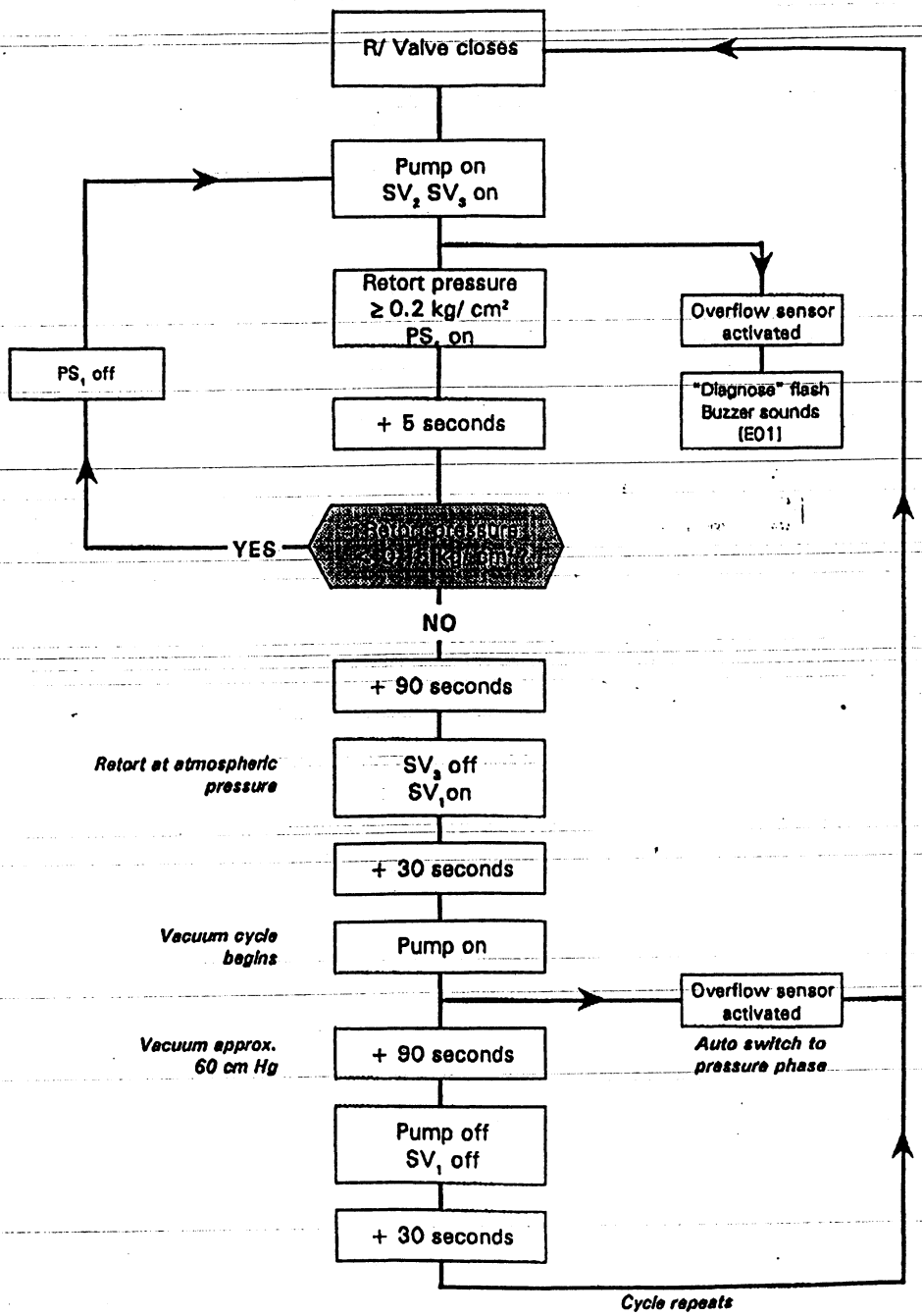


Figure 1-3. Air/Vacuum System Fluid Flow Diagram, Pump Out



Overflow

Pump

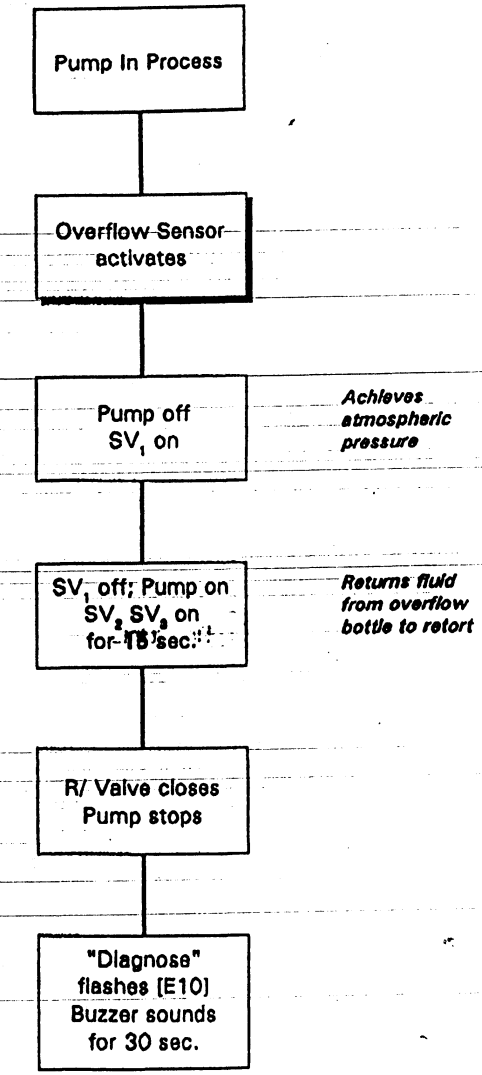
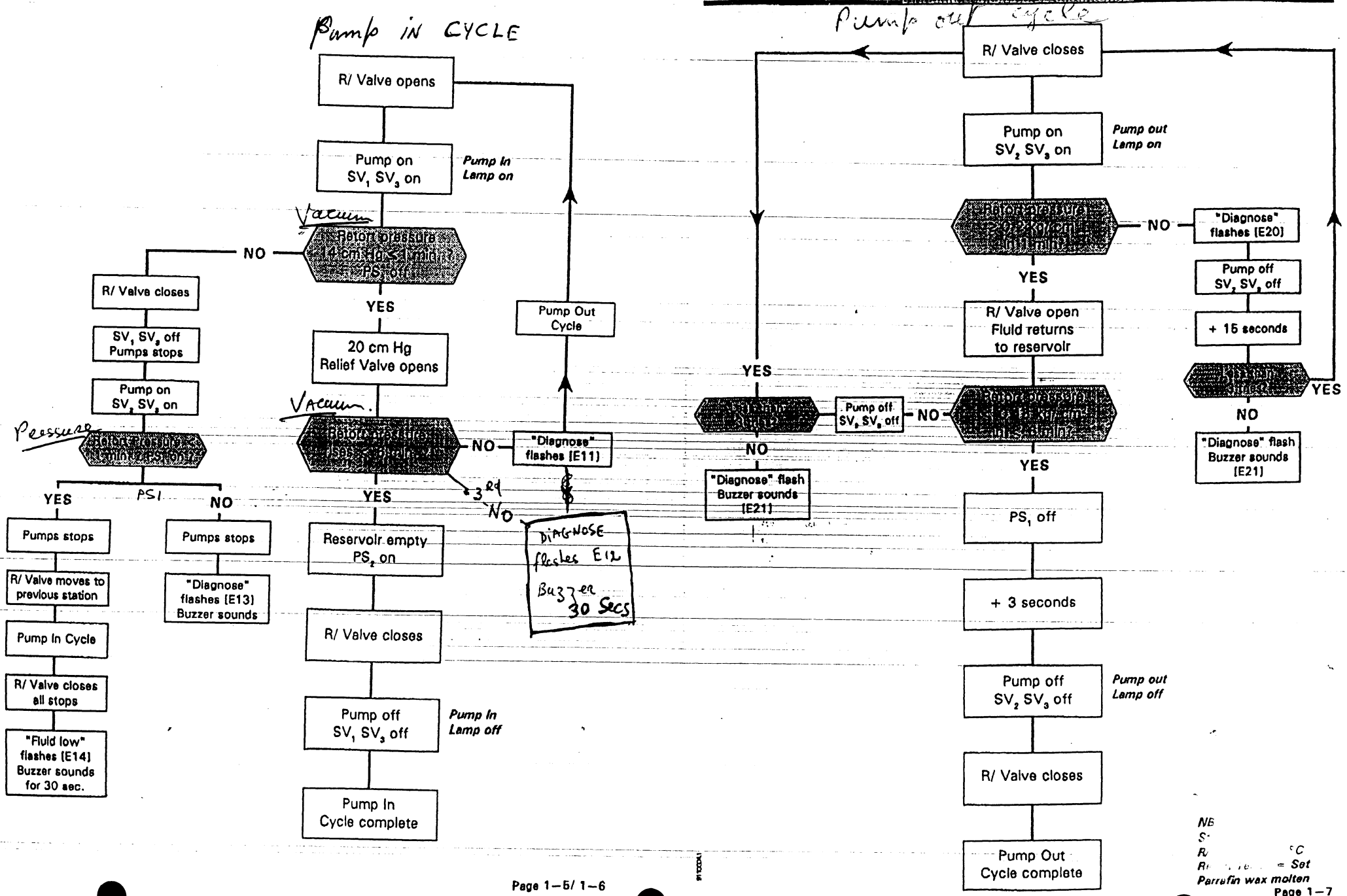
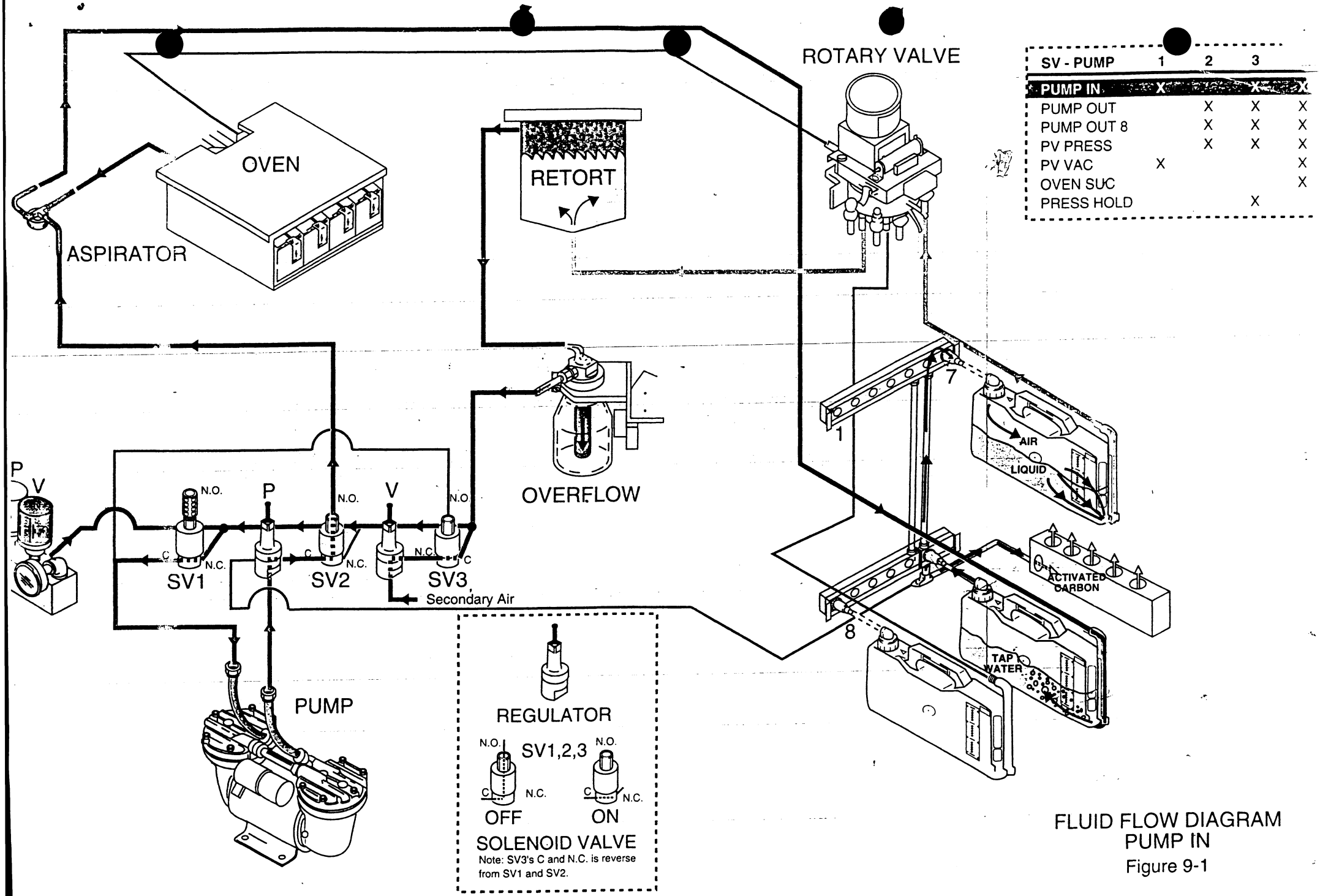


Figure 6-5 Interconnect Block Diagram

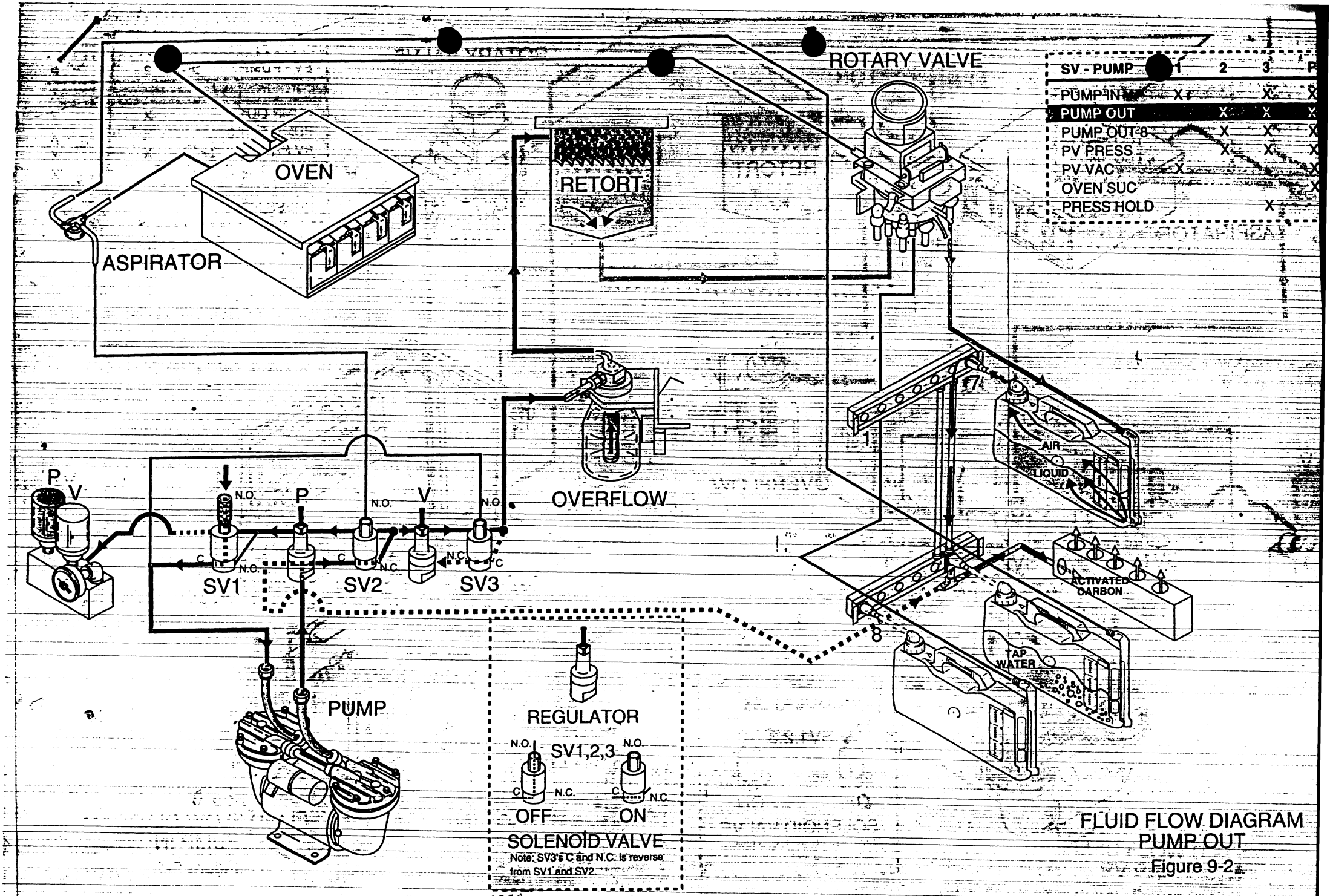


NB
S
R °C
R = Set
Paraffin wax molten



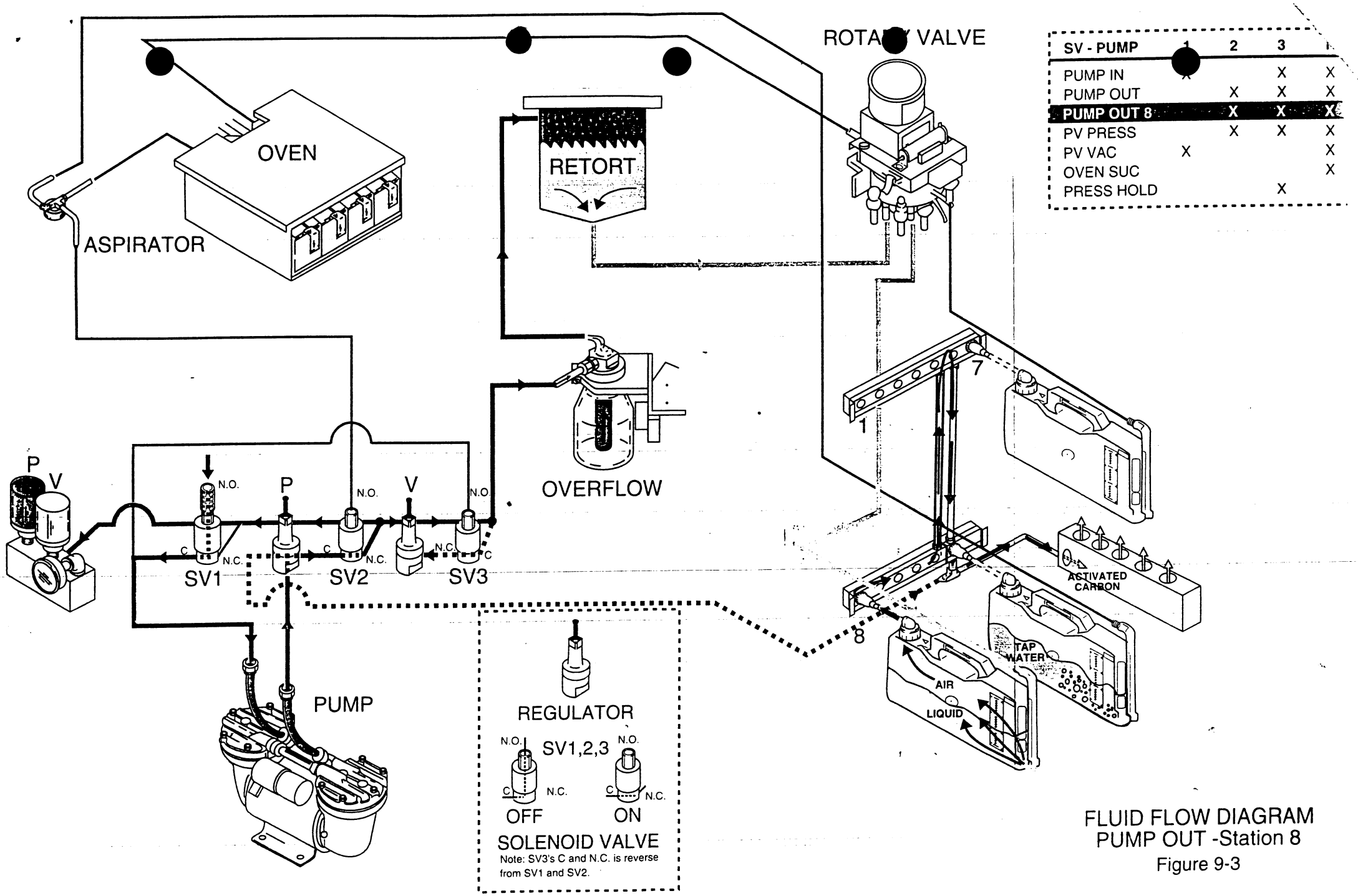
SV - PUMP	1	2	3
PUMP IN	X		X
PUMP OUT		X	X
PUMP OUT 8		X	X
PV PRESS		X	X
PV VAC	X		
OVEN SUC			
PRESS HOLD			X

FLUID FLOW DIAGRAM
PUMP IN
Figure 9-1



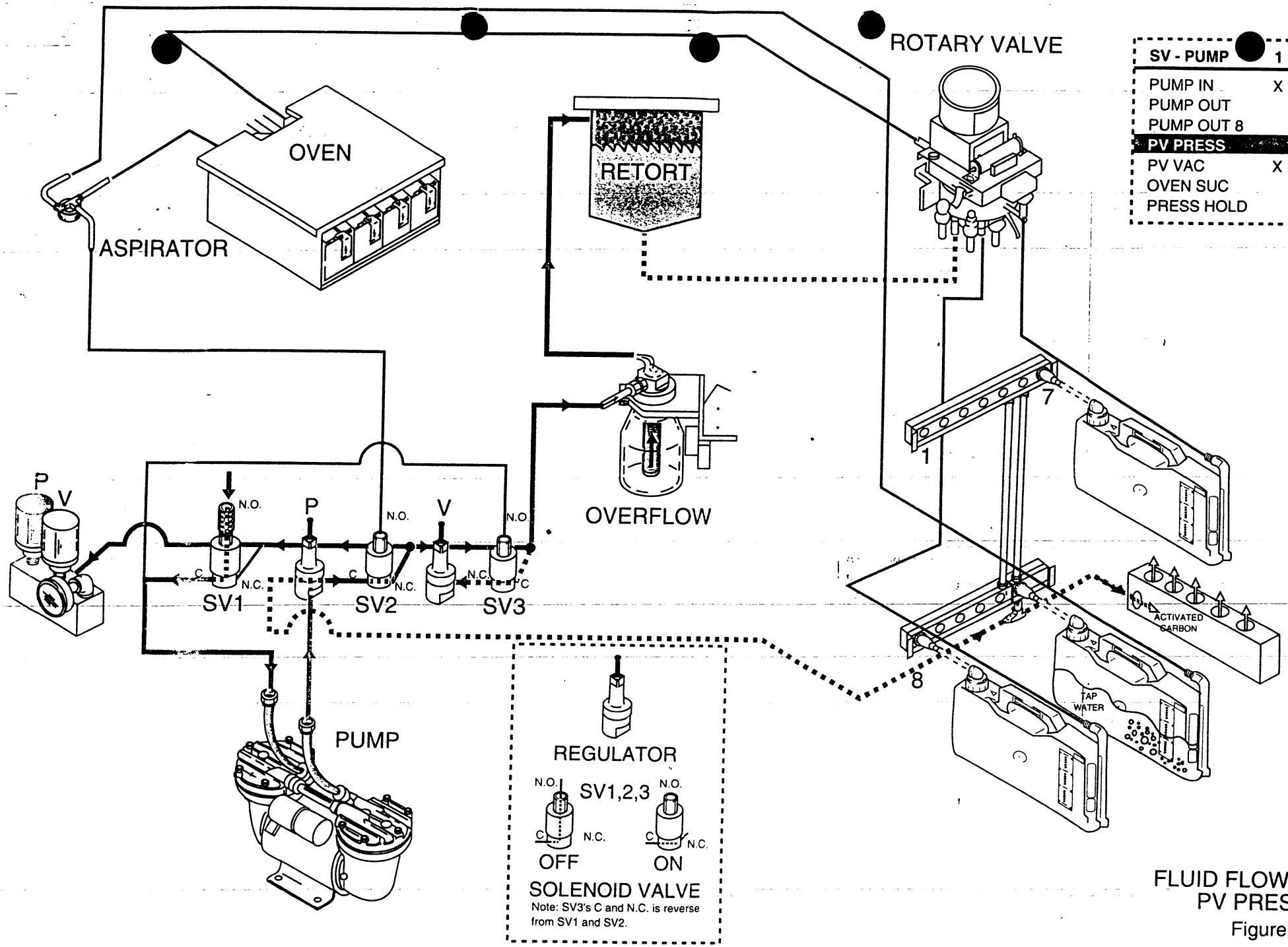
FLUID FLOW DIAGRAM
PUMP OUT

Figure 9-2



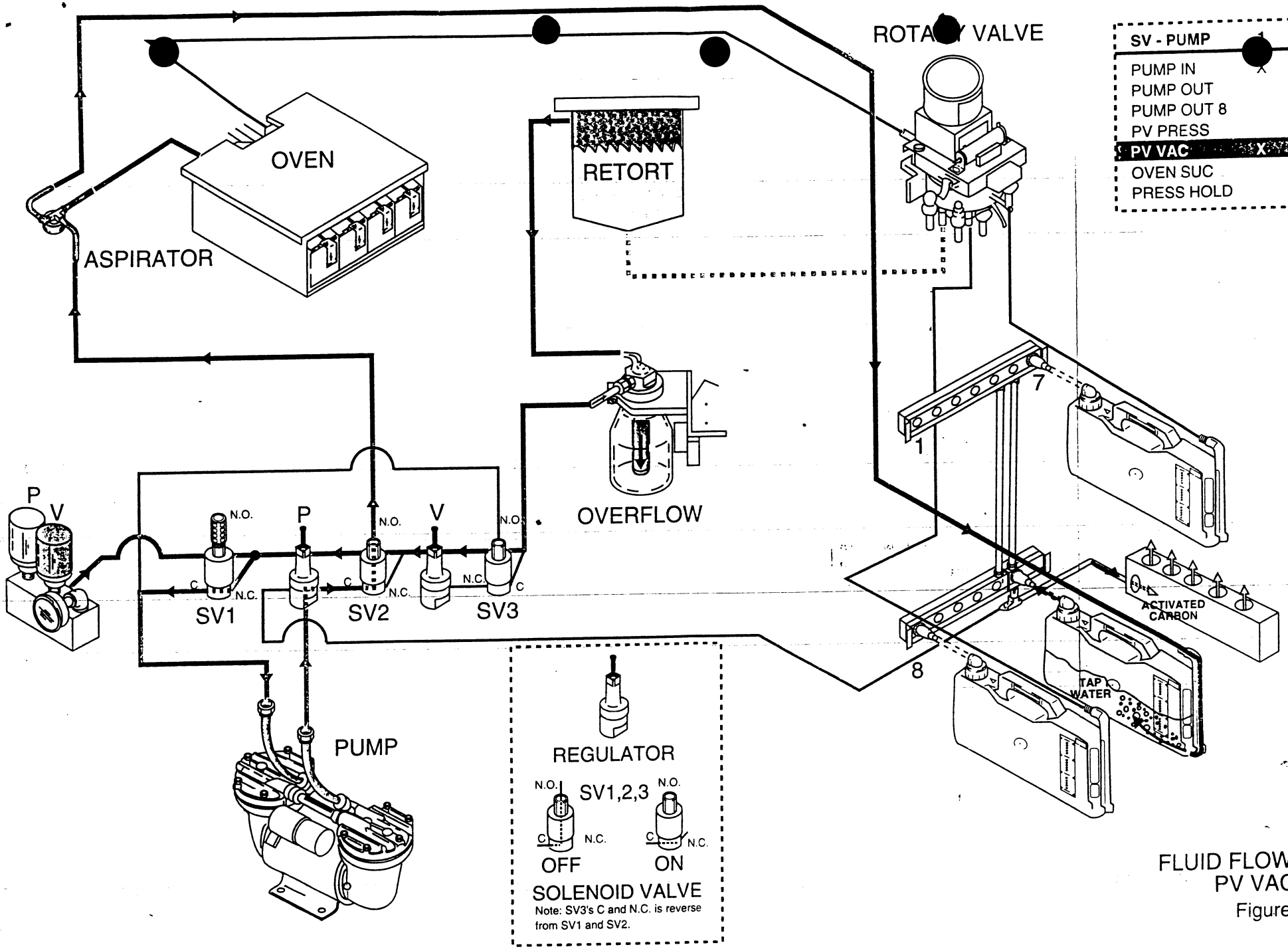
SV - PUMP	1	2	3	
PUMP IN	X		X	X
PUMP OUT		X	X	X
PUMP OUT 8		**X**	**X**	**X**
PV PRESS		X	X	X
PV VAC	X			X
OVEN SUC				X
PRESS HOLD			X	

FLUID FLOW DIAGRAM
PUMP OUT -Station 8
Figure 9-3



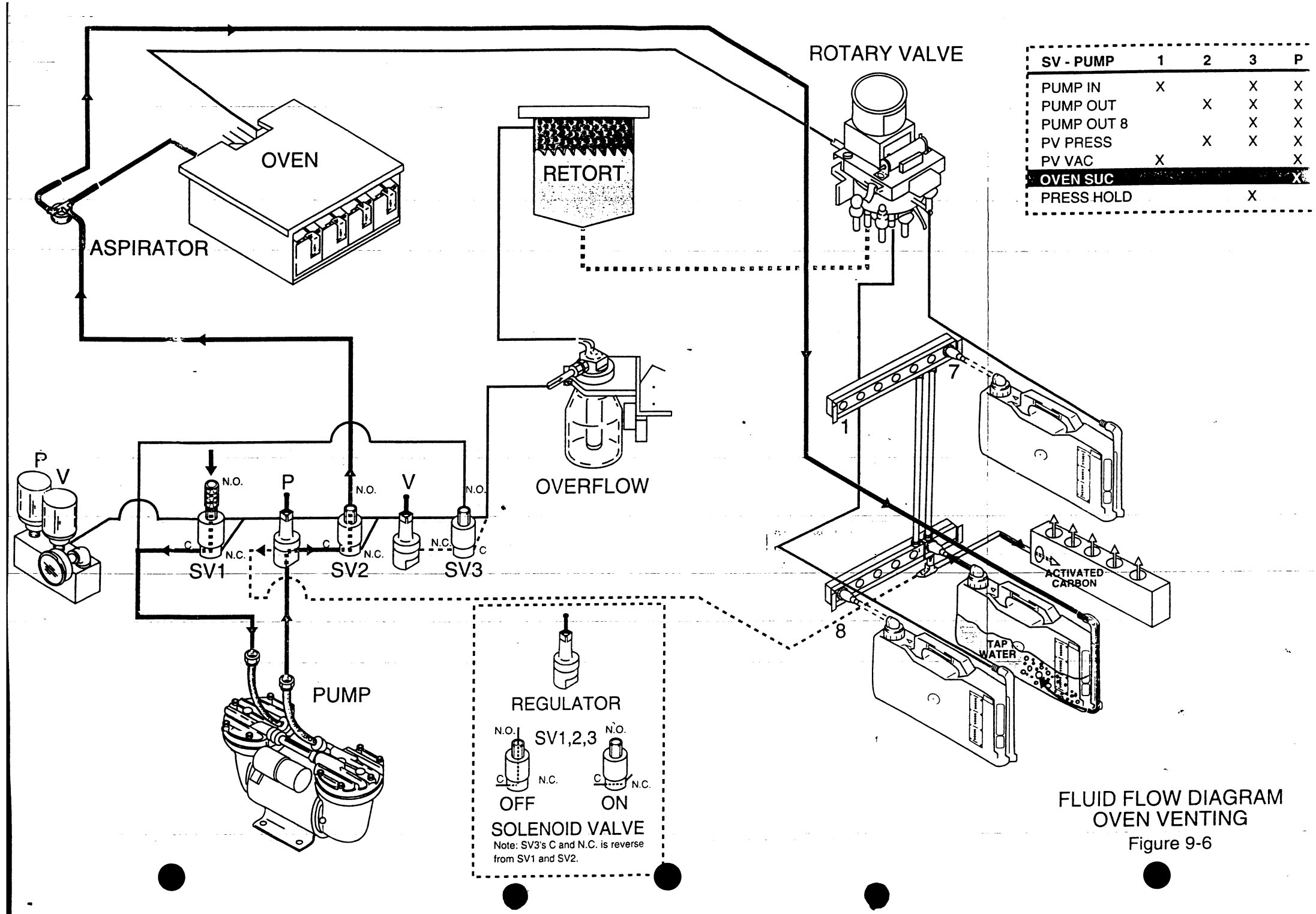
SV - PUMP	1	2	3	P
PUMP IN	X		X	X
PUMP OUT		X	X	X
PUMP OUT 8		X	X	X
PV PRESS		X	X	X
PV VAC	X			X
OVEN SUC				X
PRESS HOLD			X	

FLUID FLOW DIAGRAM
PV PRESSURE
Figure 9-4



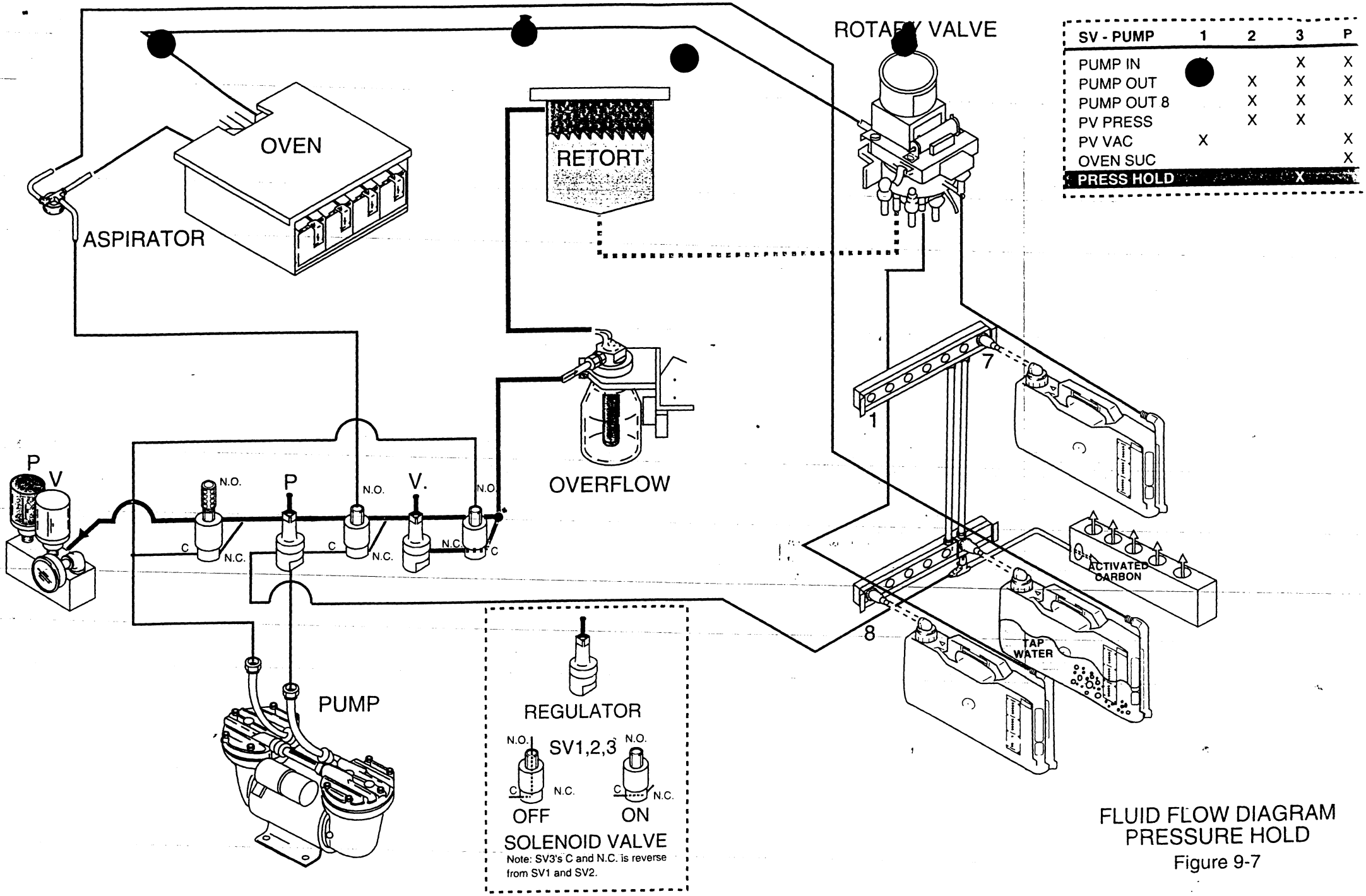
SV - PUMP	1	2	3	
PUMP IN	X		X	X
PUMP OUT		X	X	X
PUMP OUT 8			X	X
PV PRESS		X	X	
PV VAC	X			X
OVEN SUC				X
PRESS HOLD			X	

FLUID FLOW DIAGRAM
PV VACUUM
Figure 9-5



SV - PUMP	1	2	3	P
PUMP IN	X		X	X
PUMP OUT		X	X	X
PUMP OUT 8			X	X
PV PRESS		X	X	X
PV VAC	X			X
OVEN SUC				X
PRESS HOLD			X	

FLUID FLOW DIAGRAM
OVEN VENTING
Figure 9-6



SV - PUMP	1	2	3	P
PUMP IN			X	X
PUMP OUT		X	X	X
PUMP OUT 8		X	X	X
PV PRESS		X	X	
PV VAC	X			X
OVEN SUC				X
PRESS HOLD			X	

FLUID FLOW DIAGRAM
PRESSURE HOLD

Figure 9-7